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NEW CHAPTERS IN THE WARFARE OF SCIENCE.

X. THE FALL OF MAN AND ANTHROPOLOGY.

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PART II.

WE have seen that, closely connected with the main lines of investigation in Archæology and Anthropology, there were other researches throwing much light on the entire subject. In a previous chapter we saw especially how Lafitau and Jussieu were among the first to collect and compare facts bearing on the natural history of man, gathered by travelers in various parts of the earth, thus laying foundations for the science of Comparative Ethnology. It was soon seen that Ethnology had most important bearings upon the question of the material, intellectual, moral, and religious evolution of the human race; in every civilized nation, therefore, appeared eminent men who began to study the characteristics of various groups of men as ascertained from travelers, and to compare the results thus gained with each other and with those obtained by Archæology.

Thus, more and more clear became the evidences that the tendency of the race has been upward from low beginnings. It was found that groups of men still existed possessing characteristics of those in the early periods of development to whom the drift and caves and shell-heaps and pile-dwellings bear witness; groups of men using many of the same implements and weapons, building their houses in the same way, seeking their food by the same means, enjoying the same amusements, going through the same general stages of culture; some being in a condition corresponding to the earlier, some to the later periods.

From all sides thus came evidence that we have still upon

the earth examples of all the main stages in the development of human civilization; that from the period when man appears little above the brutes, and with little if any religion in any accepted sense of the word, these examples can be arranged in an ascending series leading to the highest planes which humanity has reached; that philosophic observers may among these examples study existing beliefs, usages, and institutions back through earlier and earlier forms until, as a rule, the whole evolution can be easily divined if not fully seen. Moreover, the basis of the whole structure became more and more clear; the declaration that "the lines of intelligence have always been what they are, and have always operated as they do now—that man has progressed from the simple to the complex, from the particular to the general."

As this evidence from Ethnology became more and more strong, its significance to Theology aroused attention, and naturally most determined efforts were made to break its force. On the Continent the two great champions of the Church in this field were De Maistre and De Bonald; but the two attempts which may be especially recalled as the most influential among English-speaking peoples were those of Whately, Archbishop of Dublin, and the Duke of Argyll.

First in the combat against these new deductions of science was Whately. He was a strong man, caring little for conventionalities, whose breadth of thought and liberality in practice deserved all honor; but these very qualities drew upon him the distrust of his orthodox brethren, and while his writings were powerful in the first half of the present century to break down many bulwarks of unreason, he seems to have been constantly in fear of losing touch with the Church, and therefore to have promptly attacked some scientific reasonings, which, had he been a layman, not holding a brief for the Church, he would probably have studied with more care and less prejudice. He was not slow to see the deeper significance of Archæology and Ethnology in their relations to the theological conception of "the fall," and he set the battle in array against them.

His contention was, to use his own words, that "no community ever did or ever can emerge unassisted by external helps from a state of utter barbarism into anything that can be called civilization"; and that, in short, all imperfectly civilized, barbarous, and savage races are but fallen descendants of races more fully civilized. This view was urged with his usual ingenuity and vigor; but the facts proved too strong for him: they made it clear, first, that many races were without simple possessions, instruments, and arts which never, probably, could have been lost if once acquired—as, for example, pottery, the bow for shooting, various domesticated animals, spinning, the simplest principles of agriculture, house-

hold economy, and the like; and, secondly, it was shown as a simple matter of fact that various savage and barbarous tribes *had* raised themselves by a development of means which no one from outside could have taught them; as in the cultivation and improvement of various indigenous plants, such as the potato and Indian corn among the Indians of North America; in the domestication of various animals peculiar to their own regions, such as the llama among the Indians of South America; in the making of sundry fabrics out of materials and by processes not found among other nations, such as the bark cloth of the Polynesians, and in the development of weapons peculiar to sundry localities, but known in no others; such as the boomerang in Australia.

Most effective in bringing out the truth were such works as those of Sir John Lubbock and Tylor; and so conclusive were they, that the arguments of Whately were given up as untenable by the other of the two great champions above referred to, and an attempt was made by him to form the diminishing number of thinking men supporting the old theological view on a new line of defense.

This second champion, the Duke of Argyll, was a man of much knowledge and strong powers in debate, whose high moral sense was amply shown in his adhesion to the side of the American Union in the struggle against disunion and slavery, despite the overwhelming majority against him in the high aristocracy to which he belongs. As an honest man and close thinker, the duke was obliged to give up completely the theological view of the antiquity of man. The whole biblical chronology as held by the universal Church, "always, everywhere, and by all," he sacrificed, and gave all his powers in this field to support the theory of "the fall." *Noblesse oblige;* the duke and his ancestors had been for centuries the chief pillars of the Church of Scotland, and it was too much to expect that he could break away from a tenet which forms really its "chief corner-stone."

Acknowledging the weakness and insufficiency of Archbishop Whately's argument, the duke took the ground that the lower, barbarous, savage, brutal races were the remains of civilized races which, in the struggle for existence, had been pushed and driven off to remote and inclement parts of the earth where the conditions necessary to a continuance in their early civilization were absent; that, therefore, the descendants of primeval, civilized men degenerated and sank in the scale of culture. To use his own words, the weaker races were "driven by the stronger to the woods and rocks," so that they became "mere outcasts of the human race."

In answer to this, while it was conceded, first, that there have been examples of weaker tribes sinking in the scale of culture

after escaping from the stronger into regions unfavorable to civilization, and, secondly, that many powerful nations have declined and decayed, it was shown that the men in the most remote and unfavorable regions have not always been the lowest in the scale; that men have been frequently found "among the woods and rocks" in a higher state of civilization than on the fertile plains, such examples being cited as Mexico, Peru, and even Scotland; and that while there were many examples of special and local decline, overwhelming masses of facts point to progress as a rule.

The improbability, not to say impossibility, of many of the conclusions arrived at by the duke appeared more and more strongly as more became known of the lower tribes of mankind. It was necessary on his theory to suppose many things which our knowledge of the human race absolutely forbids us to believe: for example, it was necessary to suppose that the Australians or New Zealanders, having once possessed so simple and convenient an art as that of the potter, had lost every trace of it; and that the same tribes, having once had so simple a means of saving labor as the spindle or small stick weighted at one end for spinning, had given it up and gone back to twisting threads with the hand. In fact, it was necessary to suppose that one of the main occupations of man from "the beginning" had been the forgetting of simple methods, processes, and implements, which all experience in the actual world teaches us are never entirely forgotten by peoples who have once acquired them.

Some leading arguments of the duke were overthrown by simple statements of fact. Thus, his instance of the Eskimo as pushed to the verge of habitable America, and therefore living in the lowest depths of savagery, which even if it were true by no means proved a general rule, was deprived of its force by the simple fact that the Eskimo are by no means the lowest race on the American continent, and that various tribes far more centrally and advantageously placed, as, for instance, those in Brazil, are really inferior to them in the scale of culture. Again, his statement that "in Africa there appear to be no traces of any time when the natives were not acquainted with the use of iron" is met by the fact that from the Nile Valley to the Cape of Good Hope we find, wherever examination has been made, the same early stone implements which in all other parts of the world precede the use of iron, some of which at least would not have been made had their makers possessed iron. The duke also tried to show that there were no distinctive epochs of stone, bronze, and iron, by adducing the fact that some stone implements are found even in some high civilizations. This is indeed a fact. We find some few European peasants to-day using stone mallet-heads; but this

proves simply that the old stone mallet-heads have survived as implements cheap and fairly effective.

The argument from Comparative Ethnology in support of the view that the tendency of mankind is upward has received strength from many sources. Comparative Philology shows that in the less civilized, barbarous, and savage races childish forms of speech prevail;—frequent reduplications and the like, of which we have survivals in the later and even in the most highly developed languages. In various languages, too, we find relics of ancient modes of thought in the simplest words and expressions used for arithmetical calculations. Words and phrases for this purpose are frequently found to be derived from the words for hands, feet, fingers, and toes, just as clearly as in our own language some of our simplest measures of length are shown by their names to have been measures of parts of the human body, as the cubit, the foot, and the like, and therefore to date from a time when exactness was not required. To add another out of many examples, it is found to-day that various rude nations go through the simplest arithmetical processes by means of pebbles. Into our own language through the Latin has come a word showing that our distant progenitors reckoned in this way. The word *calculate* gives us an absolute proof of this. According to the theory of the Duke of Argyll, men ages ago used pebbles (calculi) in performing the simplest arithmetical calculations because we to-day "*calculate.*" No reduction to absurdity could be more thorough. The simple fact must be that we "calculate" because our remote ancestry used pebbles in their arithmetic.

So, too, Comparative Literature and Folk-Lore show childish modes of viewing nature and childish ways of expressing the relations of man to nature among peoples of a low culture to-day, such as clearly survive from a remote ancestry; noteworthy among these are the beliefs in witches and fairies, and multitudes of popular and poetic expressions in the most civilized nations.

So, too, Comparative Ethnography, the basis of Ethnology, shows in contemporary barbarians and savages a childish love of playthings and games, of which we have many survivals.

All these facts, which were at first unobserved, or observed as a matter of no significance, have been brought into connection with a fact in Biology acknowledged alike by all important schools, by Agassiz on one hand and by Darwin on the other—namely, as stated by Agassiz, that "the young states of each species and group resemble older forms of the same group," or, as stated by Darwin, that "in two or more groups of animals, however much they may at first differ from each other in structure and habits, if they pass through closely similar embryonic stages, we may

feel almost assured that they have descended from the same parent form, and are therefore closely related."*

The history of Art, especially as shown by Architecture, in the noblest monuments of the most enlightened nations of antiquity, also gives abundant proofs of this same upward tendency from the rudest and simplest beginnings. Many columns of early Egyptian temples or tombs are but bundles of Nile reeds slightly conventionalized in stone: the temples of Greece, including not only the earliest forms, but the Parthenon itself, while in parts showing an evolution out of Egyptian architecture, exhibit frequent reminiscences and even imitations of earlier constructions in wood: the mediæval cathedrals, while evolved out of Roman and Byzantine structures, constantly show unmistakable survivals of prehistoric construction.†

So, too, History has come in, illustrating the unknown from

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* For the stone forms given to early bronze axes, etc., see Nilsson, Primitive Inhabitants of Scandinavia, London, 1868, Lubbock's Introduction, p. xxxi; and for Plates, see Lubbock's Prehistoric Man, chapter ii; also Cartailhac, Les Âges Préhistoriques de l'Espagne et du Portugal, p. 227; also Keller, Lake Dwellings; also Troyon, Habitations Lacustres; also Boyd Dawkins, Early Man in Great Britain, p. 292; also Lubbock, p. 6; also Lyell, Antiquity of Man, chap. ii. For the cranogs, etc., in the north of Europe, see Munro, Ancient Scottish Lake Dwellings, Edinburgh, 1882. For mounds and greater stone constructions in the extreme south of Europe, see Cartailhac's work on Spain and Portugal above cited, Part III., chap. iii. For the source of Mr. Southall's contention, see Brugsch, Egypt of the Pharaohs. For the two sides of the question whether in the lowest grades of savagery there is really any recognition of a superior power, or anything which can be called, in any accepted sense, religion, compare Quatrefages with Lubbock, in works already cited. For a striking but rather *ad captandum* effort to show that there is a moral and religious sense in the very lowest Australian tribes, see one of the discourses of Archbishop Vaughan on Science and Religion. For one out of multitudes of striking and instructive resemblances in ancient stone implements and those now in use among sundry savage tribes, see comparison between old Scandinavian arrow-heads and those recently brought from Tierra del Fuego, in Nilsson as above, especially in Plate V. For a brief and admirable statement of the arguments on both sides, see Sir J. Lubbock's Dundee paper, given in the appendix to the American edition of his Origin of Civilization, etc. For the general argument referred to between Whately and the Duke of Argyll on one side and Lubbock on the other, see Lubbock's Dundee paper as above cited; Tylor, Early History of Mankind, especially p. 193; and the Duke of Argyll, Primeval Man, Part IV. For difficulties of savages in Arithmetic, see Lubbock, Origin of Civilization, New York, 1889, pp. 459 *et seq.* For a very temperate and judicial view of the whole question, see Tylor, Early History of Mankind, chap. vii., especially pp. 188–191, also chap. xiii. For a brief summary of the scientific position regarding the stagnation and deterioration of races, resulting in the statement that such deterioration "in no way contradicts the theory that civilization itself is developed from low to high stages," see Tylor, Anthropology, chap. i.

† For striking examples of the testimony of language to upward progress, see Tylor, chap. xii; as to evolution in Architecture, and especially of Greek forms and ornaments out of Egyptian and Assyrian, with survivals in stone architecture of forms obtained in Egypt when reeds were used, and in Greece when wood construction prevailed, see Fergusson's Hand-Book of Architecture, vol. i, pp. 100, 228, 233, and elsewhere; also Ottfried Müller, Ancient Art and its Remains, English translation, London, 1852, pp. 219, *passim*.

the known—the development of man in the prehistoric period from his development within historic times. Nothing is more evident from history than the fact that weaker bodies of men driven out by stronger do not necessarily relapse into barbarism, but frequently rise, even under the most unfavorable circumstances, to a civilization equal or superior to that from which they have been banished. Out of very many examples showing this law of upward development, a few may be taken as typical. The Slavs, who sank so low under the pressure of stronger races that they apparently gave the modern world a new word to express the most hopeless servitude, have developed powerful civilizations peculiar to themselves; the barbarian tribes who, ages ago, took refuge amid the sand-banks and morasses of Holland, have developed one of the world's leading centers of civilization; the wretched peasants who about the fifth century took refuge from invading hordes among the lagoons and mud-banks of Venetia, developed a power in art, arms, and politics which is among the wonders of human history; the Puritans, driven from the civilization of great Britain to the unfavorable climate, soil, and circumstances of early New England; the Huguenots, driven from France, a country admirably fitted for the highest growth of civilization, to various countries far less fitted for such growth; the Irish peasantry driven in vast numbers from their own island to other parts of the world, on the whole less fitted to them—all are proofs that, as a rule, bodies of men once enlightened, when driven to unfavorable climates and brought under the most depressing circumstances, not only retain what enlightenment they have, but go on increasing it. Besides these, we have such cases as those of criminals banished to various penal colonies from whose descendants has been developed a high civilization; and of pirates, like those of the Bounty, whose descendants, in a remote Pacific island, became sober, steady citizens; thousands of examples show the prevalence of this same rule—the rule that men in masses do not forget the main gains of their civilization, and that their tendency is upward.

Another class of historic facts also testifies in the most striking manner to this same upward tendency—the decline and destruction of various civilizations brilliant but hopelessly vitiated. These catastrophes are seen more and more to be but steps in this development. The crumbling away of the great ancient civilizations based upon despotism, whether the despotism of monarch, priest, or mob—the decline and fall of Roman civilization, for example, which, in his most remarkable generalization, Guizot has shown to have been necessary in the development of the richer civilization of modern Europe; the terrible struggle and loss of the Crusades, which once appeared to be a mere catastrophe, but

are now seen to have brought on the downfall of feudalism, and the centralizing, civilizing monarchical period; the French Revolution, once thought a mere outburst of diabolic passion, but now seen to be a transition from the monarchical to the constitutional epoch—all show that even wide-spread deterioration and decline, even indeed the greatest political and moral catastrophes, so far from leading to a fall of mankind, tend in the long run to raise humanity to higher planes.

Thus, then, Anthropology and its handmaids Ethnology, Philology, and History, have wrought out, beyond a doubt, proofs of the upward evolution of humanity since the appearance of man upon our planet.

And these researches have not been confined to progress in man's material condition. Far more important evidences have been found of upward evolution in his family, social, moral, intellectual, and religious relations. The light thrown on this subject by such men as Lubbock, Tylor, Herbert Spencer, Buckle, Draper, Max Müller, and a multitude of others, despite mistakes, haltings, stumblings, and occasional following of delusive paths, is among the greatest glories of the century now ending. From all these investigators in their various fields, holding no brief for any system sacred or secular, but seeking truth as truth, comes the same general testimony of the evolution of higher out of lower. The process has been indeed slow and painful, but this does not prove that it may not become more rapid and less fruitful in sorrow as humanity goes on.*

While, then, it is not denied that many instances of retrogression can be found, the consenting voice of unbiased investigators in all lands has declared more and more that the beginnings of our race must have been low and brutal, and that the tendency has been upward. To combat this conclusion by examples of decline and deterioration here and there, has become impossible: as well try to prove that, because in the Mississippi there are eddies in which the currents flow northward, there is no main stream flowing southward; or that, because trees decay and fall, there is no law of upward growth from germ to trunk, branches, foliage, and fruit.

A very striking evidence that the theological theory had become untenable was seen when its main supporter in the scientific field, Von Martius, in the full ripeness of his powers, publicly declared his conversion to the scientific view.

Yet, while the tendency of enlightened human thought in recent times is unmistakable, the struggle against the older view is

* As to the good effects of migration, see Waitz, Introduction to Anthropology, London, 1863, p. 345.

not yet ended. The bitterness of the Abbé Hamard in France has been carried to similar and even greater extremes among sundry Protestant bodies in Europe and America. The simple truth of history makes it a necessity, unpleasant though it be, to chronicle two typical examples in our own land and time.

In the year 1875 a leader in American industrial enterprise created at the capital of a Southern State a university which bore his name. It was given into the hands of one of the religious sects most powerful in that region, and a Bishop of that sect became its President. To its chair of Geology was called Alexander Winchell, a scholar who had already won eminence as a teacher and writer in that field, a professor greatly beloved and respected in the two universities with which he had been connected, and a member of the sect which the institution of learning above referred to represented.

But his relations to this Southern institution were destined to be brief. That his lectures at the Vanderbilt University were learned, attractive, and stimulating even his enemies were forced to admit; but he was soon found to believe that there had been men earlier than the period assigned to Adam, and even that all the human race are not descended from Adam. His effort in this was to reconcile science and Scripture, and he was now treated by a Methodist Episcopal Bishop in Tennessee just as, two centuries before, La Peyrère had been treated for a similar effort by a Roman Catholic Vicar-General in Belgium. The publication of a series of articles on the subject, contributed by the professor to a Northern religious newspaper at its own request, brought matters to a climax, for, the articles having fallen under the notice of the leading Southwestern organ of the denomination controlling the Vanderbilt University, the result was a most bitter denunciation of Prof. Winchell and of his views. Shortly afterward the professor was told by Bishop McTyeire that "our people are of the opinion that such views are contrary to the plan of redemption," and was requested by the bishop to quietly resign his chair. To this the professor made the fitting reply: "If the board of trustees have the manliness to dismiss me for cause, and declare the cause, I prefer that they should do it; no power on earth could persuade me to decline."

"We do not propose," said the bishop, with quite gratuitous suggestiveness, "to treat you as the Inquisition treated Galileo."

"But what you propose is the same thing," rejoined Dr. Winchell. "It is ecclesiastical proscription for an opinion which must be settled by scientific evidence."

Twenty-four hours later Dr. Winchell was informed that his chair had been abolished, and its duties, with its salary, added to those of a colleague; the public were given to understand that

the reasons were purely economic; the banished scholar was heaped with official compliments, evidently in hope that he would keep silence.

Such was not Dr. Winchell's view. In a frank letter to the leading journal of the university town he stated the whole matter. The intolerance-hating press of the country, religious and secular, did not hold its peace. In vain the authorities of the university waited for the storm to blow over. It was evident, at last, that a defense must be made, and a local organ of the sect, which, under the editorship of a fellow-professor, had always treated Dr. Winchell's views with the luminous inaccuracy which usually characterizes a professor's ideas of a rival's teachings, assumed the task. In the articles which followed, the usual scientific hypotheses as to the creation were declared to be "absurd," "vague and unintelligible," "preposterous and gratuitous." This new champion stated that "the objections drawn from fossiliferous strata and the like are met by reference to the analogy of Adam and Eve, who presented the phenomena of adults when they were but a day old, and by the flood of Noah and other cataclysms, which, with the constant change of nature, are sufficient to account for the phenomena in question"!

Under inspiration of this sort, the Tennessee Conference of the religious body in control of the university had already in October, 1878, given utterance to its opinion of unsanctified science as follows: "This is an age in which scientific atheism, having divested itself of the habiliments that most adorn and dignify humanity, walks abroad in shameless denudation. The arrogant and impertinent claims of this science, 'falsely so called,' have been so boisterous and persistent, that the unthinking mass have been sadly deluded; but our university alone has had the courage to lay its young but vigorous hand upon the mane of untamed Speculation and say, 'We will have no more of this.'"

It is a consolation to know how the result, thus devoutly sought, has been achieved, for in the "ode" sung at the laying of the corner-stone of a new theological building of the same university, in May, 1880, we read:

> "Science and Revelation here
> In perfect harmony appear,
> Guiding young feet along the road
> Through grace and nature up to God.

It is also pleasing to know that while an institution calling itself a university thus violated the fundamental principles on which any institution worthy of the name must be based, another institution which has the glory of being the first in the entire North to begin something like a university organization—the State University of Michigan—recalled Dr. Winchell at once to

his professorship, and has honored itself by maintaining him in that position, where, unhampered, he has ever since been able to utter his views in the midst of the largest body of students on the American continent.

Disgraceful as this history was to the men who drove out Dr. Winchell, they but succeeded, as various similar bodies of men making similar efforts have done, in advancing their supposed victim to higher position and more commanding influence.*

A few years after this suppression of earnest Christian thought at an institution of learning in the western part of our Southern States, there appeared a similar attempt in sundry Southeastern States.

As far back as the year 1857 the Presbyterian Synod of Mississippi passed the following resolution:

"*Whereas*, We live in an age in which the most insidious attacks are made on revealed religion through the natural sciences, and as it behooves the Church at all times to have men capable of defending the faith once delivered to the saints;

"*Resolved*, That this presbytery recommend the endowment of a professorship of Natural Science as connected with revealed religion in one or more of our theological seminaries."

Pursuant to this resolution such a chair was established in the theological seminary at Columbia, S. C., and James Woodrow was appointed professor. Dr. Woodrow seems to have been admirably fitted for the position—a devoted Christian man, accepting the Presbyterian standards of faith in which he had been brought up and at the same time giving every effort to acquaint himself with the methods and conclusions of science. To great natural endowments he added constant labors to arrive at the truth in this field. Visiting Europe, he made the acquaintance of many of the foremost scientific investigators, became a student in university lecture-rooms and laboratories, an interested hearer in scientific conventions, and a correspondent of leading men of science at home and abroad. As a result he came to the conclusion that the hypothesis of evolution is the only one which explains various leading facts in natural science. This he taught, and he

* For Dr. Winchell's original statements, see Adamites and Pre-Adamites, Syracuse, N. Y., 1878. For the first important denunciation of his views, see the St. Louis Christian Advocate, May 22, 1878. For the conversation with Bishop McTyeire, see Dr. Winchell's own account in the Nashville American, June 16, 1878. For the curious reply from Dr. Winchell's colleague, see the Nashville Christian Advocate, July 12, 1878; and for the further development of the matter, see the Nashville American of July 19, 1878. For the further course of the attack in the denominational organ of Dr. Winchell's oppressors, see the Nashville Christian Advocate, April 26, 1879. For the oratorical declaration of the Tennessee Conference upon the matter, see the Nashville American, October 15, 1878; and for the "ode" regarding the "harmony of science and revelation" as supported at the university, see the Nashville American, May 2, 1880.

also taught that such a view is not incompatible with a true view of the sacred Scriptures.

In 1882 and 1883 the board of directors of the theological seminary, in fear that "skepticism in the world is using alleged discoveries in science to impugn the Word of God," requested Prof. Woodrow to state his views in regard to evolution. The professor complied with this request in a very powerful address, which was published and widely circulated, to such effect that the board of directors shortly afterward passed resolutions declaring the theory of evolution as defined by Prof. Woodrow not inconsistent with perfect soundness in the faith.

In the year 1884 alarm regarding Dr. Woodrow's teachings began to show itself in larger proportions, and a minority report was introduced into the Synod of South Carolina declaring that "the synod is called upon to decide not upon the question whether the said views of Dr. Woodrow contradict the Bible in its highest and absolute sense, but upon the question whether they contradict the interpretation of the Bible by the Presbyterian Church in the United States."

Perhaps a more self-condemnatory statement was never presented, for it clearly recognized, as a basis for intolerance, at least a possible difference between "the interpretation of the Bible by the Presbyterian Church" and the teachings of "the Bible in its highest and absolute sense."

This hostile movement became so strong that, in spite of the favorable action of the directors of the seminary, and against the efforts of a broad-minded minority in the representative bodies having ultimate charge of the institution, the delegates from the various synods raised a storm of orthodoxy and drove Dr. Woodrow from his post. Happily, he was at the same time professor in the University of South Carolina in the same city of Columbia, and from his chair in that institution he continued to teach natural science with the approval of the great majority of thinking men in that region; hence, the only effect of the attempt to crush him was, that his position was made higher, respect for him deeper, and his reputation wider.

In spite of attempts by the more orthodox to prevent students of the theological seminary attending his lectures at the university, they persisted in hearing him; indeed, the reputation of heresy seemed to enhance his influence.

It should be borne in mind that the professor thus treated had been one of the most respected and beloved university instructors in the South during more than a quarter of a century, and that he was turned out of his position with no opportunity for careful defense, and indeed without even the formality of a trial; well did an eminent but thoughtful divine of the Southern Presbyte-

rian Church declare that "the method of procedure to destroy evolution by the majority in the Church is vicious and suicidal," and that "logical dynamite has been used to put out a supposed fire in the upper stories of our house, and all the family in the house at that." Wisely, too, did he refer to the majority as "sowing in the fields of the Church the thorns of its errors, and cumbering its path with the *débris* and ruin of its own folly."

To these recent cases may be added the expulsion of Prof. Toy from teaching under ecclesiastical control at Louisville, and his election to a far more influential chair at Harvard University; the driving out from the American College at Beyrout of the young professors who accepted evolution as probable, and the rise of one of them at least, Mr. Nimr, to a far more commanding position than that which he left—the control of three leading journals at Cairo; the driving out of Robertson Smith from his position at Edinburgh, and his reception into the far more important and influential professorship at the English University of Cambridge; and multitudes of similar cases. From the days when Cotton Mather drove out Henry Dunster, the first President of Harvard College, for "falling into the briers of Antipedobaptism" until now, the same spirit is shown in all such attempts. In each we have generally on one side a body of the older theologians who, since their youth, have learned nothing and forgotten nothing, sundry professors who do not wish to rewrite their lectures, and a mass of unthinking ecclesiastical persons of little or no importance save in making up a retrograde majority in an ecclesiastical tribunal; on the other side we have as generally the thinking, open-minded, devoted men who have listened to the revelation of their own time, as well as of times past, and who are evidently thinking the future thought of the world.

Here we have survivals of that same oppression of thought by theology which has cost the modern world so dear; the system which forced great numbers of professors, under penalty of deprivation, to teach that the sun and planets revolve about the earth; that comets are fire-balls flung by an angry God at a wicked world; that insanity is diabolic possession; that anatomical investigation of the human frame is sin against the Holy Ghost; that chemistry leads to sorcery; that taking interest for money is forbidden by Scripture; that Geology must conform to ancient Hebrew poetry. From the same source came in Austria the rule of the "Immaculate Oath," under which university professors, long before the dogma of the Immaculate Conception was defined by the Church, were obliged to swear to their belief in that dogma before they were permitted to teach even Arithmetic or Geometry: in England, the denunciation of inoculation against smallpox; in Scotland, the protests against using chloroform in child-

birth as "vitiating the primal curse against woman"; in France, the use in clerical schools of a historical text-book from which Napoleon was left out; and, in America, the use of manuals in which the Inquisition is declared to be a purely civil tribunal, or the Puritans tolerant.

So, too, among multitudes of similar efforts, abroad we have during centuries the fettering of professors at English and Scotch universities by test oaths, subscriptions to articles and catechisms without number. In our own country we have had in a vast multitude of denominational colleges, as the first qualification for a professorship, not ability in the subject to be taught, but fidelity to the particular shibboleth of the denomination controlling the college or university.

Happily, in these days such attempts generally defeat themselves. The supposed victim is generally made a man of mark by persecution, and advanced to a higher and wider sphere of usefulness. As regards withstanding the march of scientific truth, any opposing Conference, Synod, Board of Commissioners, Board of Trustees, or Faculty, is but as a nest of field-mice in the path of a steam plow.

The harm done to religion in these attempts is far greater than that done to science; for thereby suspicions are widely spread, especially among open-minded young men, that the accepted Christian system demands a concealment of truth, with the persecution of honest investigators, and therefore must be false. Well was it said in substance by President McCosh, of Princeton, that no more sure way of making unbelievers in Christianity among young men could be devised than preaching that the doctrines arrived at by the great scientific thinkers of this period are opposed to religion.

Yet it is but justice here to say that more and more there is evolved out of this past history of oppression a better spirit which is making itself manifest with power in the leading religious bodies of the world. In the Church of Rome we have to-day such utterances as those of St. George Mivart, declaring that the Church must not attempt to interfere with science; that the Almighty in the Galileo case gave her a distinct warning that the priesthood of science must remain with the men of science. In the Anglican Church and its American daughter we have the acts and utterances of such men as Archbishop Tait, Dean Stanley, and many others, proving that the deepest religious thought is more and more tending to peace rather than warfare with science; and in the other churches, especially in America, while there is yet much to be desired, the welcome extended in many of them to Alexander Winchell, and the freedom given to views like his, augur well for a better state of things in the future.

From the science of Anthropology, when rightly viewed as a whole, has come the greatest aid to those who work to advance Religion rather than to promote any particular system of Theology; for Anthropology and its subsidiary sciences show more and more that man, since coming upon the earth, has risen, from the period when he had little, if any, ideas of a great power above him, through successive stages of fetichism, shamanism, and idolatry toward better forms of belief, making him more and more accessible to nobler forms of religion. The same sciences show, too, within the historic period the same tendency, and especially within the events covered by our sacred books, a progress from fetichism, of which so many evidences crop out in the early Jewish worship as shown in the Old Testament Scriptures, through polytheism, when Jehovah was but "a god above all gods," through the period when he was "a jealous God," capricious and cruel, until he is revealed in such inspired utterances as those of the nobler Psalms, the great passages in Isaiah, the sublime preaching of Micah, and, above all, through the ideal given to the world by Jesus of Nazareth.

Well indeed has an eminent divine of the Church of England in our own time called on Christians to rejoice over this evolution "between the God of Samuel, who ordered infants to be slaughtered, and the God of the Psalmist, whose tender mercies are over all his works; between the God of the Patriarchs, who was always repenting, and the God of the Apostles, who is the same yesterday, to-day, and forever, with whom there is no variableness nor shadow of turning; between the God of the Old Testament, who walked in the garden in the cool of the day, and the God of the New Testament, whom no man hath seen nor can see; between the God of Leviticus, who was so particular about the sacrificial furniture and utensils, and the God of the Acts, who dwelleth not in temples made with hands; between the God who hardened Pharaoh's heart, and the God who will have all men to be saved; between the God of Exodus, who is merciful only to those who love him, and the God of Christ—the heavenly Father—who is kind unto the unthankful and the evil."

However overwhelming, then, the facts may be which Anthropology and its kindred or subsidiary sciences may, in the interest of simple truth, establish against the theological doctrine of "the fall"; however completely they may fossilize various dogmas, catechisms, creeds, confessions, "plans of salvation" and "schemes of redemption," which have been evolved from the great minds of the theological period; science, so far from making inroads on religion, or even upon our Christian development of it, will strengthen all that is essential in it, giving new and nobler paths to man's highest aspirations. For the one great legitimate, scien-

tific conclusion of Anthropology is that more and more a better civilization of the world, despite all its survivals of savagery and barbarism, is developing men and women on whom the declarations of the nobler Psalms, of Isaiah, of Micah, the Sermon on the Mount, the first great commandment, and the second, which is like unto it, and St. James's definition of "pure religion and undefiled," can take stronger hold for the more effective and more rapid uplifting of our race.*

BARRIER BEACHES OF THE ATLANTIC COAST.

By FREDERICK J. H. MERRILL, Ph. D.

FROM Cape Cod to Cape Florida our coast is fringed with barrier beaches. They are the reefs of sand which protect the mainland shore from the storm-waves of the ocean. Isolated and uninhabited were most of these sea-born barriers for a long period in the history of our country, but the need of a breathing-place on the part of the thousands who inhabit our crowded cities has caused, within a few years, a great transformation. Railroad and turnpike bridges have been built, connecting many of them with the shore. Hotels and cottages, club-houses and bathing-houses, in short, buildings for every purpose which contributes to the pleasure and comfort of man have sprung up, as it were by magic, on the south shore of Long Island, on the coast

* For the resolution of the Presbyterian Synod of Mississippi in 1857, see Prof. Woodrow's speech before the Synod of South Carolina, October 27 and 28, 1884, p. 6. As to the action of the Board of Directors of the Theological Seminary of Columbia, see *ibid.* As to the minority report in the Synod of South Carolina, see *ibid.*, p. 24. For the pithy sentences regarding the conduct of the majority in the synods toward Dr. Woodrow, see the Rev. Mr. Flinn's article in the Southern Presbyterian Review for April, 1885, p. 272 and elsewhere. For the restrictions regarding the teaching of the Copernican theory and the true doctrine of comets in the German University, see various histories of astronomy, especially Mädler. For the immaculate oath (Immaculaten Eid) as enforced upon the Austrian professors, see Luftkandl, Die Josephinischen Ideen. For the effort of the Church in France, after the restoration of the Bourbons, to teach a history of that country from which the name of Napoleon should be left out, see Father Loriquet's famous Histoire de France à l'Usage de la Jeunesse, Lyon, 1820, vol. ii; see especially table of contents at the end. The book bears on its title-page the well-known initials of the Jesuit motto A. M. D. G. (Ad Majorem Dei Gloriam). For examples in England and Scotland, see various English histories, and especially Buckle's chapters on Scotland. For a longer collection of examples showing the suppression of anything like unfettered thought upon scientific subjects in our American colleges, see Inaugural Address at the Opening of Cornell University by the author of these chapters. For the citation regarding the evolution of better and nobler ideas of God, see Church and Creed: Sermons preached in the Chapel of the Foundling Hospital, London, by A. W. Momerie, M. A., LL. D., Professor of Logic and Metaphysics in King's College, London, London, 1890.

of New Jersey, Virginia, and the Carolinas, on the famed sea-islands of Georgia, and on the coast of eastern Florida.

Much alike are these peninsulas and islands wherever we view them along the coast. The chief variation is in the vegetation which clothes them. The beaches of Long Island are almost barren, but from New Jersey southward many are covered with dense forests which vary in their trees according to the latitude. At Sandy Hook, oaks, red cedars, hollies, maples, and sassafras-trees grow in wonderful luxuriance. On Seven-Mile Beach and Holly Beach the swamp magnolia abounds among the others. In the Carolinas the palmetto appears, often ragged in outline and blighted by the winter frosts. In northern Florida the palmettos are more numerous and show the influence of a warmer climate, while on the southern extremity of the zone of barrier beaches the cocoanut palm, planted by accident or design, rears its leafy crown in luxuriant verdure.

It is not the design of the writer to describe in detail the beaches of the Atlantic coast, but rather to consider their history and mode of growth. As it has been his fortune to spend much time on the sea-shore of New Jersey, he proposes to discuss the barrier beaches of that State as types of their genus.

They are sandy islands and peninsulas, from two to twenty miles in length and from half a mile to a mile in width, separated by inlets and usually divided from the mainland by an interval of several miles, in which are broad expanses of salt meadow, fringing and separating a series of channels, bays, and sounds.

The beaches which are now in their highest state of development are Sandy Hook, Seven-Mile Beach, and Holly Beach near Cape May. These typical examples of the sea-born barriers are much alike in structure, and consist of four principal divisions. The first division, or interior, is an undulating area covered with heavy timber, of which the size suggests its age. Immense hollies, oaks, pines, and red cedars abound, many of the first measuring two feet in diameter, and some of the latter attaining a circumference of four or five yards. The sassafras grows in remarkable luxuriance and immense grape-vines are everywhere to be seen, overhanging a dense undergrowth. In spring and summer the ground is covered with fragrant blossoms; columbines, violets, pinks, orchids, and a host of other flowers lend their bright colors to enhance the varied greens of the foliage. This is the beach primeval. Skirting it seaward is the second division, which bears smaller timber. Low cedars, hollies, and pines are here the chief forms of arboreal vegetation, and fewer flowering plants are seen. This zone is of later formation, and its trees are younger than those of the first. Adjoining it is the third division, which consists of a belt of undulating dunes a few hundred feet or yards

in width, and bearing the mossy Hudsonia or scrubby bushes of beach plum and wax-myrtle, or in some places, especially on the outer row of dunes, only supporting a meager growth of beach grass. Frequently, between two rows of dunes, an expanse of salt meadow occurs, or a sand flat bearing stunted forms of plant life. With this third division ends the domain of vegetation, succeeded by the sloping strand upon which the tide rises and falls. The sand-bar, exposed at low water at the extremity of the beach, is constantly increased in length and height by the action of the currents, and the process of beach formation is here continually in progress.

As the tide falls, the sand laid bare is rapidly dried by the wind and carried above high-water mark. Then, safe beyond the reach of the waves, the minute particles are borne still farther from the water, and striking against some piece of drift-wood, bush, or tuft of grass, quickly build a hillock, which grows larger and larger as more sand falls upon it, and a dune is formed many feet in height. The material of which these dunes are composed is never at rest, but flies hither and thither with the wind, and a hillock ten or fifteen feet high to-day may noiselessly be taken down to-morrow and rebuilt a hundred yards away. In time, as the beach grows seaward and the dunes increase in number, those of earlier formation, which are somewhat protected from the breeze, catch a few seeds, and tufts of grass begin to grow upon them. Still later, the mossy Hudsonia or some starveling wax-myrtle finds a little sustenance, and as years elapse the dunes become so thickly covered with vegetation that under the protection of the seaward hillocks they retain their form with comparatively little change.

Thus have the beaches grown. First a sand flat built by ocean waves and currents; then a series of low, shifting dunes; next sheltered hillocks, on which grasses and shrubs fasten their protecting roots; succeeding the latter a growth of small cedars and pines; and, finally, as centuries roll on, majestic forest trees raise their spreading tops and shelter a dense undergrowth.

These few words suffice to describe the beaches' growth, their physiology; but many pages might be written upon their history, the details of their development, their changes and their decay. Unfortunately, the records are but incomplete. From the memories of old men we can glean some facts in regard to the former condition and extent of certain beaches and concerning marked changes in them which have been notable events to men of quiet lives. In a few instances, surveys were made a century or two ago which can be compared with those of to-day. At present we can watch the changes which occur from year to year. As geological science advances we can speculate concerning the past on

the basis of present knowledge and observation. We have little accurate information, but, after all, we have much that is interesting.

The beach of Sandy Hook forms the northern extremity of the New Jersey sea-coast. Previous to 1778 it was connected with the base of the Navesink Highlands by a sandy isthmus, the mouths of the Navesink and Shrewsbury Rivers being open to the east; but from that date until about 1830, and from 1848 until 1889, it has been united with the mainland at Monmouth Beach by a narrow strip of sand.

According to records in the office of the Surveyor-General of East Jersey and in that of the United States Coast Survey, the point of Sandy Hook advanced northward about one mile between 1685 and 1885. The lighthouse was built about 1764 near the water's edge, and the ground on which it stands had then existed for only fifteen years as a portion of *terra firma*.

In 1844 the point was about two hundred and fifty yards north of its present limit. Since that date it has receded slowly toward the south, and toward the west has extended a quarter of a mile. We have no evidence concerning the date of formation of the old "Hook" which existed before 1685. It is now well marked by immense forest trees, which exceed in height and size of trunk any of their species known to the writer in the neighborhood of New York.

The rapid growth of Sandy Hook is due to a current which flows northward from the vicinity of Manasquan, carrying with it a great quantity of sand removed from the water front of Asbury Park, Long Branch, Seabright, and that vicinity, which is dropped along the border of the "Hook" and its extremity. The investigations of the United States Coast and Geodetic Survey have shown that the ebb and flow of the tides from and to New York Bay produce this current by drawing a stream of water through False Hook Channel, which lies between Sandy Hook and a submerged bar called False Hook half a mile to the east. The stream flows northward more than seven hours out of twelve, and from this fact property-owners in the neighborhood of Long Branch may appreciate what becomes of their real estate when it disappears during the storms. If there were any means of identifying the soil, it might all be found on the rapidly growing point of Sandy Hook.

About 1778 a channel was opened across the narrow isthmus which united Sandy Hook with the base of the Navesink Highlands, and a new passage being thus afforded for the tidal currents of the Navesink and Shrewsbury Rivers, the old Shrewsbury Inlet, which formed the common mouth of those two estuaries, was gradually closed by the northward extension of the sand-spit

which formed the southern limit, and in 1810 became impassable. The barrier thus formed existed until 1830 or 1831, when it was broken through and a second inlet was created. By a change in the tidal currents, due to the formation of this new inlet, the isthmus which formerly connected Sandy Hook with the Highlands of Navesink was again brought into existence and remained until 1835. An artificial channel was then cut through it, and this being gradually deepened and widened by the ebb and flow of the tides, has ever since remained open. The second Shrewsbury inlet closed in 1840 near Island Beach, having moved northward nearly three miles during its existence of nine or ten years. In 1837 or 1838 the third and last inlet opened near the present Bellevue Hotel, and afforded a better channel for navigation than the second inlet, which it followed in its northward course and survived by about eight years. From 1848 until September, 1889, no inlet has been opened; but this fact is due rather to the efforts of the railroad company to maintain its road-bed than to a diminution of the tendency of the waves and tidal currents to open a passage.

The facts and dates concerning the Shrewsbury Inlets have been obtained chiefly by inquiry from old fishermen and sailors who have spent their lives on or near the waters of the Navesink and Shrewsbury Rivers. Coming from a number of independent sources, they agree very closely, and those here given may be accepted as worthy of credence. The tendency of the inlets to work northward, periodically closing and reopening farther south, has been observed in all those between Point Pleasant and Sandy Hook, especially in those of Manasquan and Shark Rivers. Between Point Pleasant and Cape May, however, all the inlets are moving southward.

From Monmouth to the head of Barnegat Bay there is no beach similar to that of Sandy Hook. Instead of a sand-reef separated from the main land by a navigable channel, there is only the sloping strand adjoining, as at Long Branch, the foot of an upland bluff, or as at Spring Lake, Seagirt, and Point Pleasant, with its crest on a level with the surface of the upland. Between Bay Head and Cape May, however, there are twelve beaches, mostly well developed and preserved, and named respectively Squan, Island, Long, Island or Little, Brigantine, Absecon, Peck's, Ludlam's, Seven Mile, Five Mile or Holly, Two Mile, and Poverty. The majority of these, however, do not show the high degree of development exhibited by Seven-Mile and Five-Mile Beaches. Some appear to be only in the earlier stages of growth, while others have passed their prime and are now yielding to the attacks of wind and wave.

These agents have been hitherto considered only with reference

to their constructive effect on the beaches, and it now remains to consider their destructive action.

When the wind blows from the west it carries back to the sea much of the sand which the east wind had piled up in dunes, and, but for the fact that the latter wind prevails, the sand-hills would not long exist. By a surplus of constructive action, however, the beaches are all moving to the west. Year after year sand is removed from their eastern margin by the winter storms, and carried north or south according to the direction of the prevailing current. The winds from the ocean drive the dunes westward, and, with the possible exception of Sandy Hook, all the beaches are now underlaid by an old salt meadow, originally formed in sheltered waters on their west side. In this turf, when exposed during an unusually low tide, the footprints of cattle are seen in many places, made, it is claimed, when the salt meadow was a pasture and lay on the shoreward side of the beach. This westward recession has, in many cases, amounted to more than a mile within two centuries.

On many of the beaches south of Point Pleasant the westward progress of the dunes has been made over and through the native forest. As a result of this, gnarled cedars, dying and dead, are found among the dunes; and in many cases stumps may be seen in the sand within reach of the tide.

Near the northern end of Seven-Mile Beach, at the time of the writer's visit in 1885, an immense dune forty feet in height and half a mile in length had been for many years encroaching steadily upon the dense forest. The tree-tops here projected above the summit of the ridge like the heads of drowning men above the waves; while on the outer flank of the overwhelming mass of sand the gnarled, skeleton trunks of those which had perished in it stood bare and grim, showing with dreary grayness the fate of the earlier victims of which the ragged and wave-worn stumps alone remained. A more desolate scene the writer has never witnessed.

At Long Branch the wear of the coast has been very great. According to the United States Coast and Geodetic Survey, a strip of land varying from three hundred to five hundred feet in width was removed between Deal Beach and Monmouth during the twenty-seven years preceding 1868. In the vicinity of Seabright the amount of wear was a little less than two hundred feet during that period. Of late years the rate of recession has been diminished in the neighborhood of Long Branch by the means of artificial protection employed, but near Seabright the shore line is said to have receded at least two hundred feet during the past quarter of a century. At Cape May the wear of the shore has been continuous except where the land is protected by jetties or

a stone sea-wall, the rate of encroachment varying from ten to thirty feet a year.

Besides these alterations produced in the beaches by their westward progress, the variations in the positions of the inlets and the subsidence of the coast have caused many important changes. The history of the Shrewsbury Inlets has already been given; it remains to mention a few of those south of Point Pleasant.

Squan and Island Beaches, which now form a peninsula about twenty miles long, terminating at Barnegat Inlet, were separated from 1750 to 1812 by Cranberry Inlet, which was nearly opposite the mouth of Tom's River. Since 1812 near the site of this old inlet there have been others of brief duration, and one is said to have existed before 1755 opposite the mouth of the Metedeconk River, which separated Squan Beach from the mainland.

The old Barnegat Lighthouse is said to have stood nearly six hundred yards north of the present south shore of the inlet, at a point now occupied by the center of the channel. In 1855 the old tower was at the water's edge, so that the inlet has moved southward approximately twenty yards per year.

Absecon Inlet, which separates Brigantine Beach from Absecon Beach, has encroached upon the latter about four hundred yards in twenty years; and the ocean front of that portion of Absecon Beach which is occupied by Atlantic City extended in 1855 nearly half a mile farther east than it did in 1885. About 1875 jetties were built which arrested the action of the tidal currents, and, the wear of the shore being thus prevented, a considerable area was restored.

Submerged tree-stumps and other evidences of a subsidence of the coast may be found on the beaches and the salt meadows, but a detailed enumeration of them would be beyond the scope of the present article.

In Cape May County the depression has not been less than twenty feet, and has possibly been much greater. The evidence of some old buildings on the shore of Delaware Bay suggests a subsidence of about four feet during the last two centuries.

It is doubtful whether depression *alone* has caused the wear of the coast. A comparison of the present outline of Holly Beach with that determined by a survey in 1772 shows an accretion on the south and east, since the latter date, more than three and a half miles long and averaging three eighths of a mile in width, and on many other beaches a similar growth has taken place. During the past five years the ocean has rapidly encroached upon these beaches, while the subsidence of the coast, so far as we know, has been uniform throughout the past two centuries. It would appear, therefore, that the growth and decay of the beaches

are more dependent upon the action of the ocean currents and winds than upon other agencies. Unquestionably the depression of the coast renders the beaches more subject to overflow and erosion by the waves and currents; but the evidence at many points shows that the latter are capable of forming large areas of beach where the conditions of their existence and action favor construction rather than destruction. While these currents act as at present, the cost of preventing the ravages of the sea, by the methods commonly in use, would probably be much greater than the value of the land protected, for the fine sand is so unstable when wet that bulkheads and breakwaters are quite ephemeral.

After an extended examination of the various systems of shore defense in use between Sandy Hook and Cape May, it appears to the writer that the only effectual means of protection is the construction of jetties extending far enough from the shore to intercept the currents which carry away the sand loosened by the waves. Such jetties have added a large area to the territory of Atlantic City, and have protected the shore at Cape May; no doubt they would be effective everywhere if properly constructed.

The experience of the past ten years on the New Jersey coast shows conclusively that the ocean front is not fit for building purposes, for it is impossible to protect a house near the water's edge from injury or destruction in the heaviest storms. The height and force of the waves in such a tempest as that of September 10 and 11, 1889, render them irresistible to any body or structure which nature or art has yet produced, and anything within their reach must suffer. The immediate water-front is only available for parks; and, if devoted to this use, when protected from the erosive action of the currents by suitable jetties, would remain a neutral ground which, in fair weather, would afford numberless attractions to the occupants of dwellings placed far enough from the strand to be out of reach of the storm-waves.

Property-owners along the ocean front of the beaches have generally made the mistake of supposing that the domain of the Atlantic was bounded by the high-water mark of the spring tides. Any one who should build a dwelling on the strand below ordinary high-water mark would be considered lacking in common sense, yet it is scarcely less foolish to build within reach of the storm-waves. It is, of course, true that many cottages are now much nearer the water's edge than they were a few years ago. This is due to the wear of the shore by currents already described as flowing parallel to it and removing the sand which the waves have loosened. If the action of these currents should be stopped —and there is good evidence to show that a system of jetties would intercept them and cause them to drop their stolen load of

sand—the wear of the shore would be arrested and the yearly encroachments of the ocean would cease.

With regard to the inundation of Atlantic City by the sea in the great September storm of 1889 it should be said that this catastrophe ought not to be considered very wonderful, since the greater portion of the city is less than ten feet above mean tide, and the highest point recorded by the New Jersey State Survey is only thirteen feet above that level. As ordinary tides rise a foot above this plane, and spring tides nearly two feet, it is evident that a prolonged easterly storm would soon cause a considerable area to be overflowed. Since the bays and channels which lie between the beach and the mainland are almost completely landlocked and the inlets are relatively narrow, the water-level is soon raised to a height of two or three feet above the meadows, and this is sufficient to cover most of the railroad tracks. To be sure, no such inundation as the recent one has occurred since Atlantic City became a place of importance, nor do the old residents on the coast remember such a storm in former years; but it is evident that, while the beaches were uninhabited, such a storm as the one in question would attract less attention, since it would cause little if any loss of property.

The genesis of the beaches is still a matter for speculation, but it may be safely affirmed that they originated as sand-bars, formed under water by wave and current action. How these bars were brought above water, so that the wind could exert its constructive power, is uncertain. A plausible hypothesis is, that while the ocean was breaking on the mainland shore and forming the Quaternary terraces, which may be seen there, sand-bars were made under water, and that the continental elevation which raised these terraces to their present position from twenty-five to eighty feet above tide, brought these sand-bars above water into a horizon of Æolian action. Once above the sea, the beaches would maintain their existence. A continued elevation of the coast would add to their seaward extent and a depression would cause a westward recession until they were brought to rest by contact with the mainland shore. In New Jersey the latter condition may be observed between Long Branch and Point Pleasant and also at Cape May.

So far as it is known to the writer, the only way in which a beach can be entirely destroyed is by an inlet shifting its position. In this case the beach obliterated is replaced by the extension of an adjacent beach.

Of the beaches south of New Jersey not enough is known to the writer to permit of a detailed biographical sketch. Their form and structure show that they have been subject to the same formative agencies and vicissitudes as those already described. In addition

to the Georgia sea-islands of *ante-bellum* fame, may be mentioned as familiar examples the barriers which in Virginia and North Carolina separate Albemarle and Pamlico Sounds from the ocean; in Florida, Amelia Island on which is built the city of Fernandina; Anastasia Island, in front of St. Augustine; and the beaches which separate Halifax and Indian Rivers from the Atlantic. The last-named rivers are the lagoons which separate the barriers from the mainland shore. Lake Worth is one of these lagoons, of which the inlet has been closed.

To what extent the Florida Keys may be included in the category of barrier beaches must be decided by future investigation. Key West is evidently a wave-built sand-bar composed of fragments of coral, molluscan shells, and foraminifera, and it seems likely that Cayo Largo and others of that type may be of similar origin. The coquina deposits of the vicinity of St. Augustine are also wave-formed.

The hypothesis of Prof. Louis Agassiz, that the Florida Keys are all of organic origin—i. e., that they were formed by the growth of coral reefs—may be true so far as the determination of their location and direction. A submerged reef of coral may have formed a nucleus on which the waves and currents deposited a load of calcareous sand, but the superficial portion is evidently similar in origin to that of the beaches farther north.

Barrier beaches are found on all the sea-coasts of the world where opportunity for their growth has been afforded, and those of New Jersey may be regarded as types of these formations in all their essential features.

ANCIENT DWELLINGS OF THE RIO VERDE VALLEY.

By EDGAR A. MEARNS,
ASSISTANT SURGEON, U. S. A.

AS an officer of the medical department of the United States Army, the writer was assigned to the military department of Arizona in 1884, and took station at Fort Verde, in the central part of that territory, in March. Strange were the sensations that we experienced on the morning succeeding our arrival, as we looked for the first time upon the broad valley of the Rio Verde, hemmed in by rugged mountains on the west, and terraced limestone cliffs with intervening *mesas* on the east. To the northward Beaver Creek poured its turbid flood into the Verde, whose banks were filled to overflowing by the waters sent down by the melting snow upon the distant Mogollon Mountains. Eighty miles to the north, beyond the ruddy cliffs of the "Red Rock Country," San Francisco Peak, the highest point and most prominent landmark in the territory, gleamed in snowy white-

ness. Indeed, it retained its snow-cap far into the hot summer months. The general course of the river at this point is a little east of south. The eye vainly followed its winding course for miles in either direction in quest of village or solitary dwelling. Not a human habitation could be seen. The handful of soldiers mounting guard upon the parade, to the music of trumpet, fife, and drum, but emphasized the solitude of the place. Trees marked the sinuous course of the stream, but the rest of the valley was bare of vegetation save patches of mesquite-bushes in the alluvial river-bottom, the ever-present cactus, aloe, and yucca, and a low growth of intermingled weeds and grasses, whose blended hues imparted to the valley a yellowish color. Dwarfed cedars and piñons barely existed upon the arid slopes of the Black Hills range, bounding the valley upon the west, and tall pines crowned their level summits.

I said there were no human habitations in sight; but closer scrutiny revealed stone edifices, erected by the hand of man, occupying commanding points upon the opposite side of the valley; huge piles of masonry, whose ruined walls still stand to a considerable height. Below these, emerging upon narrow ledges, in the face of the nearest cliffs, were lines of black holes, which I was told were entrances to the cave-dwellings of an extinct race of men. From the hospital piazza a view was obtained of a still more wonderful structure. In the vertical side of the cañon, through which Beaver Creek flows, a large building four or five stories high had been built by this people, whose only history is written in monumental ruins.

Before our departure from Fort Verde in 1888 three railroads had penetrated toward the heart of the wilderness by which we were surrounded. Settlers were thronging in to engage in lumbering, mining, or stock-grazing in the mountainous portions, or to cultivate the soil of the irrigable valleys. Already the valley of the Verde begins to assume somewhat of the appearance that it presented centuries ago, when irrigated and cultivated by the populous cliff-dwellers. Again the Indian corn rustles in the broad fields in autumn, and golden pumpkins and squashes cluster beneath the stalks. Childish voices are borne on the breeze: a new cycle begins.

Curiosity concerning the people whose stone buildings challenge attention from most of the prominent points along the Verde River and its tributary streams led me to pay some attention to the study of archæology, and to form a collection of such relics as might shed light upon the history and habits of the builders.*

* This collection, comprising several thousand specimens, has been donated to the American Museum of Natural History, New York. The human skeletons and crania will be sent to the Army Medical Museum at Washington.

On turning to the fourth volume of Hubert H. Bancroft's Native Races of the Pacific States, which is devoted to the study of antiquities, I was surprised to find that the extensive ruins of the Verde were at that time (1875) undescribed and unknown, save through vague accounts received from Mr. Leroux and other guides and trappers. On page 636 we read: "These ruins are not very far from Prescott in the north and Fort McDowell in the south; and I regret not having been able to obtain from officers in the Arizona service the information which they must have acquired respecting those remains, if they actually exist, during the past ten or fifteen years." Some of these ruins have since been examined by archæologists accompanying Government surveying parties, and models of several of them are to be seen in eastern museums; but no exhaustive account of them has ever been written, nor have any been more than superficially explored.

The writer has availed himself of the opportunity afforded by numerous tours of field-service and authorized hunting expeditions, amounting in the aggregate to several thousand miles of travel, to examine most of the principal ruins in the territory, from the famous Casa Grande of the Gila itself to the smaller *casas* and caves on the head-waters of its tributaries. Although highly diverse in form, style, material, and location, it is evident that these buildings belonged to a single race. This is shown by the similarity of products and identity of habits, as well as by the relation of the dwellings to each other. The implements and pottery found in the rude caves of the Upper Verde are identical with those which Mr. Cushing has recently obtained from the immense *casas grandes* of Salt River. In all, the food substances and mode of agriculture are essentially the same. Again, the proudest *casas grandes* are built on the summits of cliffs whose sides are honeycombed with cave-dwellings, thus combining in a single community the most diverse styles of habitations.

Only the aboriginal monuments of the Verde region will here receive attention. They are uniform with those of the rest of the Gila Basin. In fact, little violence would be done by uniting all of our southwestern ruins with those of the northern tier of Mexican States into a single group. They were the work of substantially the same people.

The accompanying map indicates the location of only such remains as are personally known to the writer. Detailed descriptions of all of them would prove tedious to the reader and exceed our present limits.

The walled buildings are of two kinds—those occupying natural hollows or cavities in the faces of cliffs, and those built in exposed situations. The former, whose walls are protected by sheltering cliffs, are sometimes found in almost as perfect a state of preserva-

MAP OF THE VERDE VALLEY, SHOWING ITS ANCIENT DWELLINGS.

tion as when deserted by the builders, unless the torch has been applied. The latter, or Pueblo style of architecture, usually occupying high points and commanding a wide extent of country, are in a ruined state, although walls are commonly standing to the height of one or more stories, with some of the timbers intact.

Another and very common form of dwellings is the caves, which are excavated in the cliffs by means of stone picks or other implements. They are found in all suitable localities that are contiguous to water and good agricultural land, but are most numerous in the vicinity of large *casas grandes.* Most of them are in limestone cliffs, as the substratum of sandstone is not as commonly exposed in the cañons and cliffs, but many cavate dwellings are in sandstone.

The additional remains observed by me are mounds in the vicinity of ancient dwellings, extensive walls of stone and mortar, large quantities of stone implements and fragments of broken pottery, *acequias* or irrigating ditches, ancient burial grounds, and hieroglyphic inscriptions on stones and cliffs—the last two to be doubtfully referred to the cliff-dwellers.

FIG. 1.—CASA GRANDE IN RIGHT BLUFF OF A CAÑON ENTERING THE VERDE RIVER FROM THE EAST, ABOUT TWELVE MILES SOUTHEAST OF FORT VERDE.

Of the cliff-houses, as contradistinguished from those of Pueblo pattern, many excellent examples are found in the Verde region. One, into which I was probably the first white man to set foot, is built in the right wall of a deep cañon, between Hackberry Flat and the Rio Verde. It was found when searching for a still larger

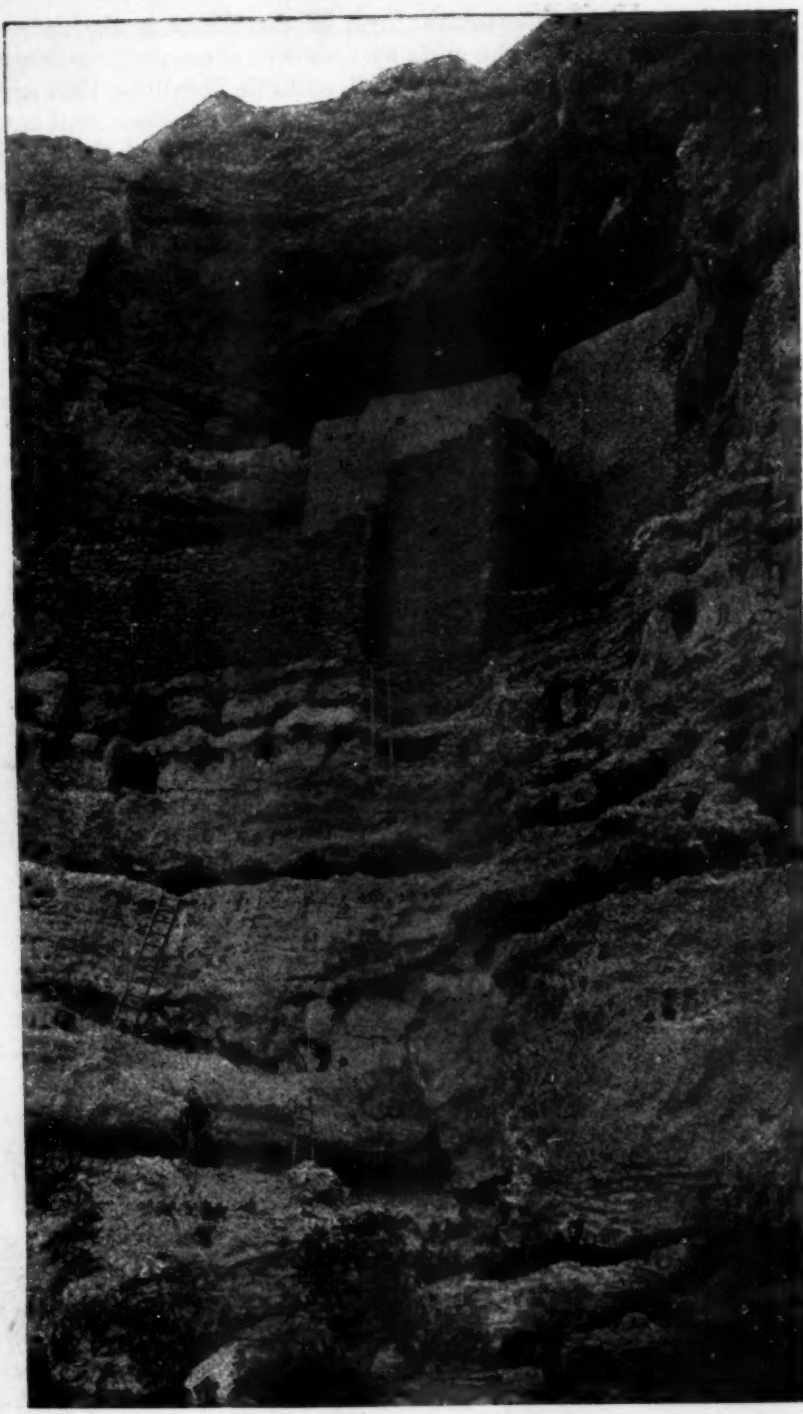


FIG. 2.—"MONTEZUMA'S CASTLE."

and more nearly perfect building near the same locality, which an old settler had found many years ago. There are many others on Beaver Creek, and in the "box cañons" of the Upper and Lower Verde.

The building known as "Montezuma's Castle," on the right bank of Beaver Creek, in sight of and three miles from Fort Verde, is (perhaps excepting a building near Salt River) the finest that I have seen, and typical of this class of structures. This *casa*, doubtless a fortress, is fitted into a natural depression, high up in a vertical limestone cliff, the base of which is distant three hundred and forty-eight feet from the edge of the stream and about forty feet above it. The *casa* is accessible only by means of ladders, its lowest foundations being forty-two feet above the bottom of the cliff. The post quartermaster of Fort Verde has provided four substantial wooden ones, which make the ascent easy from one narrow ledge to the next. After ascending three ladders a ledge is reached upon which six cave-rooms open (Fig. 3).

On a ledge eight feet below this one, and eighty feet to the northeast, are two cave-dwellings, neatly walled up in front, with a well-made window in each for entrance. There are many other cave-dwellings in the cliff, at either side of the *casa*, long lines of them extending toward the southwest. One or two isolated chambers, walled in front and windowed, may be seen far up the side of the cliff, where they are altogether inaccessible. These, together, constituted the settlement.

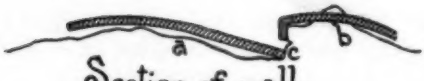
Ascending the fourth ladder (Fig. 6, *z*), the *casa* is reached. The foundation rests upon cedar timbers laid longitudinally upon flat stones on the ledge. The projecting ends of these timbers show plainly the marks of stone axes used in cutting them. The front wall (Fig. 4, *a b*) is a little over two feet wide at the bottom and thirteen inches wide at the top. It leans slightly in toward the cliff. One part of this wall (Fig. 5) rests on what appears to be a very precarious footing, although it has stood for centuries. The timbers are so placed that in the middle they project beyond the edge of the ledge.

The *casa* is entered at a projecting angle (Fig. 6, *c*), through a window of sub-Gothic form (Fig. 7), measuring three feet and three inches in height by two feet and four inches in width at the bottom. This small apartment (Fig. 6, *a*) is smoothly plastered within, and blackened by fire. The plastering bears finger-marks and impressions of the thumb and hand, showing that it was laid on and smoothed by the hands. The roof is formed by willows laid horizontally across eleven rafters of ash and black alder; upon this a thick layer of reeds is placed transversely, and the whole plastered on top with mortar, forming a floor to the chamber above it. The rafters are peeled, except one or two that

Ledge, with cliff chambers, below the Casa.

FIG. 3.

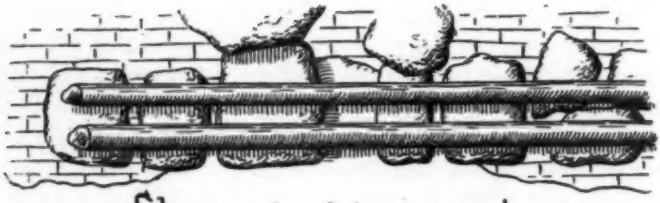
10 feet



Section of wall.

FIG. 4.

10 feet



Showing foundation support.

FIG. 5.

FIG. 7.

1 foot

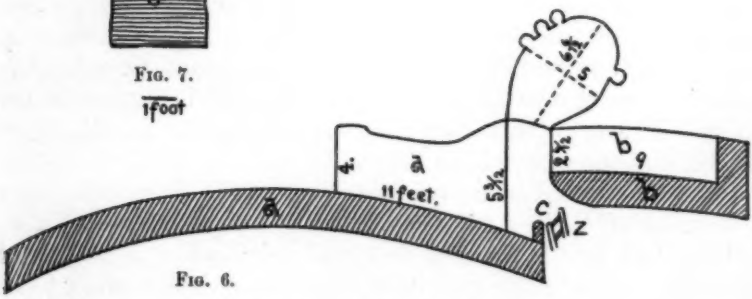


FIG. 6.

Plan of 1st floor of Casa.

10 feet.

were evidently taken dry. They average about fifteen inches in circumference, and were set into the walls at the time the latter were built. They were burned off flush with the wall outside.

Some of them show hatchet-marks, where branches were lopped off. From this room the only means of exit, except the window by which it was entered, is a small hole in the ceiling, just within the entrance (Fig. 8, *x*), measuring thirteen by eighteen inches, and bordered by flat stones laid upon the reed layer of the roof. These stones are smoothly polished by the hands of the dwellers in passing back and forth, as this was apparently the only means of entering the seventeen apartments above it. The traveler in this region is quite certain of being entertained by exaggerated stories about gigantic human skeletons having been discovered in the ruined *casas grandes;* but if he be a good-sized man, and possessed of the usual amount of adipose tissue appertaining to the age of threescore years, he will become skeptical thereof when he comes to squeeze himself through the narrow portals of the ancient halls of Montezuma's Castle.

Except a store-room, another small room (Fig. 6, *b*), separate from the one just described, is all that remains on the first floor. It can only be entered through a small scuttle in the floor of the room over it (Fig. 8, *t*).

The first and second stories occupy an outer ledge, lower than the rest of the *casa*. The great outer wall of the upper stories (Fig. 8, *c*) is founded upon a ledge in the rear of the second floor, forming its back wall.

The second story is much more spacious than the first. The roof of the latter brings the building to the level of another ledge, which, extending laterally in each direction, serves as a floor for additional rooms. This story is composed of a tier of four rooms, bounded behind by the most massive wall of masonry in the whole *casa*, which, as previously stated, rests on a ledge even with the floor of the second story. This arrangement, besides giving more room to the stories above, secured the greatest amount of stability to this wall, which is the most important in the structure. It is twenty-eight feet in height, rising to the fifth story, around the front of which it forms a battlement four and a half feet high. It leans slightly toward the cliff, and is strongly curved inward, though not symmetrically. The chord of the arc described by the top of the wall measures forty-three feet, and the greatest distance from chord to circumference eight feet. As the wall is built against the cliff, there is no way of ascertaining its thickness at the bottom. It is fourteen inches wide on top.

The third floor (Fig. 9) comprises the most extensive tier of rooms in the structure, extending across the entire alcove in the cliff in which the *casa* is built.

The balcony above rooms C and D of the second story, as stated, had a battlement around it, which is still intact where supported by the wall of room G. A portion of the flooring has

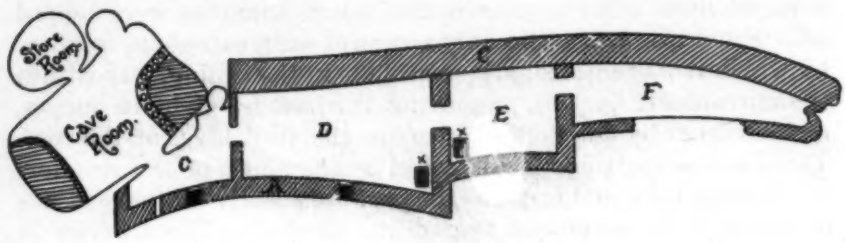


FIG. 8. Plan of 2nd Floor.

10 feet.

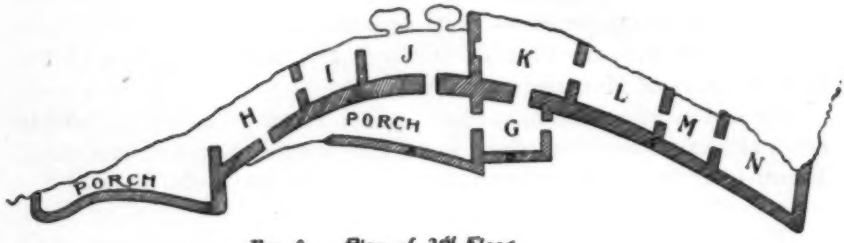


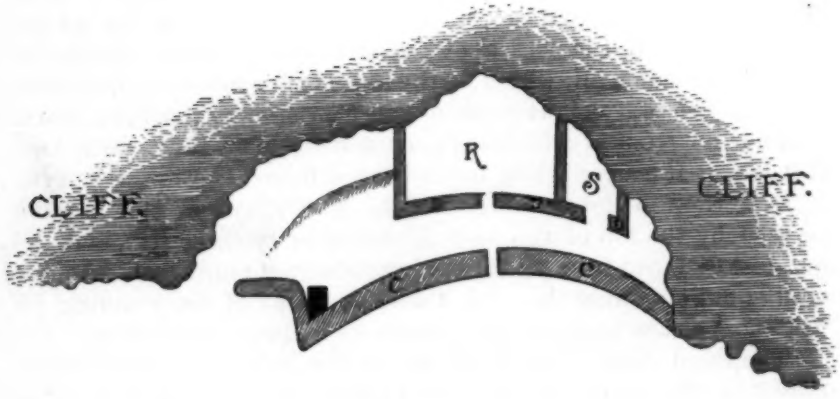
FIG. 9. Plan of 3d Floor

10 feet

FIG. 10.

Plan of 4th Floor

10 feet



10 feet.

FIG. 11. Plan of 5th Floor.

broken down into room D of the second story. *Metates* and grinding-stones were of frequent use in its construction; this and other appearances lead us to the conclusion that this remarkable structure was not built at one time, but grew up gradually from successive building. The caves in the cliff were probably first inhabited and the *casas* subsequently erected.

When taking the dimensions of room G on this floor a singular incident occurred. Mr. Daniels, my assistant, discovered a stone axe lying between the two timbers which formed the lintel of the window, the latter having been splintered by a bullet, which also struck the axe and loosened it in its position. Thus a careless shot, aimed at the building by some passing hunter, put us in possession of an interesting relic.

The apartments of the fourth floor (Fig. 10) are rather neater in construction than the rooms below, but they are otherwise so nearly alike that a detailed description would involve a needless and tiresome repetition of details. The door-ways are neatly executed, each having four good-sized lintel-pieces.

The fifth story can only be reached by climbing up through a small hole in the ceiling of room O, similar to that in room A of the first floor. This, the uppermost story (Fig. 11), consists of a long porch or gallery, having a battlement in front and an elevated backward extension on the right, with two rooms (R and S) filling the corresponding space on the left. The two rooms on this floor are roofed by the rocky arch of the cliff, and are loftier than the lower chambers.

It is said that only a few axes, *metates*, and other stone implements, with broken vessels of pottery, were found in this building when first explored by the whites. Upon my first visit, in 1884, it was evident that nothing more than a superficial examination had ever been made. In 1886 I caused the *débris* on the floors to be shoveled over. This material consisted of a quantity of dust and broken fragments of pottery and stone implements, together with an enormous accumulation of guano from bats that inhabited the building. This accumulation, in the largest room of the top floor, was four feet in depth. As no one had ever disturbed it, the floor was found in exactly the same condition in which it was left by the latest occupants. In front of the entrance the remains of a fire was found, and a goodly bundle of fagots lay against the wall at a convenient distance. An earthen vessel contained food, and a small basket of mesquite-seeds stood hard by. On further search, a large spoon of sycamore wood and some gourd cups were found. A large *metate* and grinder, weighing upward of a hundred pounds, proved to be a troublesome acquisition to our collection; but the labor expended in getting it safely down to the ground served to increase our respect

for those who carried it up. Shells and shell ornaments were secured, as well as paints of various colors. Some oven-shaped cupboards were built along the wall, containing remains of mescal, Spanish bayonet, nuts of the piñon-pine, and other food substances; and corn-cobs were found in abundance.

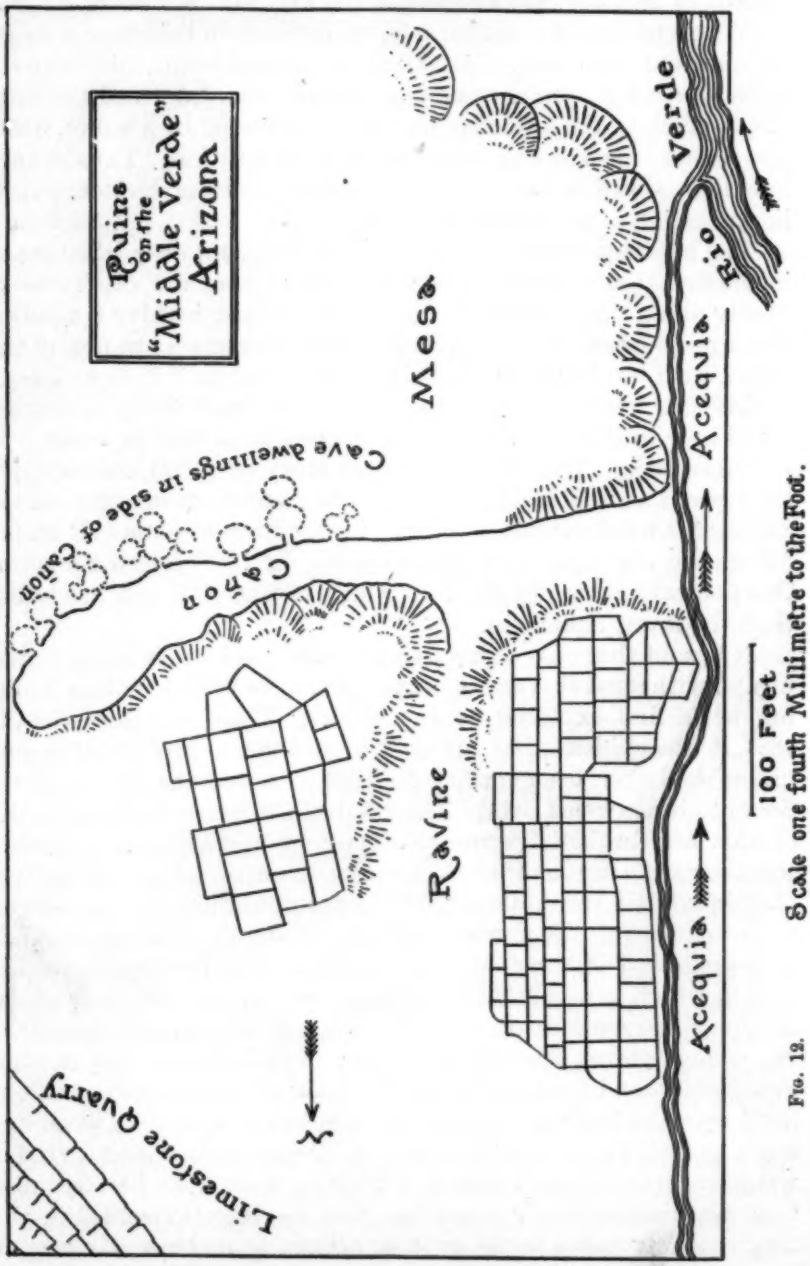


FIG. 12.

In other parts of the building several bone implements, including a corn-shucker and a handsomely wrought marlin-spike, fashioned from the leg-bone of deer, were obtained. Scalps or head-dresses were also unearthed. Indeed, the materials here found formed quite an extensive collection, including numerous food articles, bones of various animals, pieces of cloth, matting and basket-work, ropes and cords of cotton and yucca, sticks for fire-making, knitting or weaving, and many other uses.

None of the ancient buildings of this region exceed this one in picturesque grandeur, although many are more extensive. Its very location excites admiration and inspires respect for those who built it, whatever may have been the motive which prompted to the selection of such a site; nor is it lacking in architectural beauty. Its existence proves its great strength.

Of the ruined pueblos, an extensive group of buildings on the left bank of the Verde River, six miles northwest of Fort Verde, Arizona, may be fairly considered a representative example. This pueblo consisted of two terraced buildings surmounting a limestone cliff. The larger one, in which I have made some exploration, faces the Verde, the other fronting on a side cañon to the south; the walls of the latter, as well as the face of the cliff, contain numerous cave-dwellings, in which sundry articles of pottery and basket-work, as well as stone tools, were exhumed. The accompanying plan (Fig. 12) exhibits the relations of these structures. This ruin, which does not differ materially from many others in the Verde region, is quite similar to the inhabited villages of the Moquis of Eastern Arizona and the modern pueblos of New Mexico. As it was conveniently accessible from the fort, I made it the subject of some research, and caused considerable excavations to be made in parts of the larger building, and also in the caves of the adjacent cañon.

The larger edifice had been three stories in height in front, where it rested upon the level rock, thence terraced down the slope of a ravine behind it, the lower tiers of rooms having apparently been but a single story in height. Previous to my first visit the front of the building had been thrown down over the cliff by the white settlers to supply material for repairing an old *acequia*, which has since served the whites, as it did the cliff-dwellers of old, with water for irrigating purposes. Several of the ranchmen in the vicinity called my attention to articles made of pottery, and a varied assortment of interesting relics, which they had secured when tearing down the ruin, in which they claimed to have discovered dozens of human skeletons, one of gigantic stature (the usual story), and a quantity of burial urns and other vessels of pottery and stone. These accounts were in some measure substantiated by the abundance of broken pottery,

rough mortars, *metates*, and stone implements to be seen in the walls of the new *acequia*. The writer, whose appetite for discovery had been whetted by his surprising success when excavating in the high tier of cave-dwellings in the frowning cliffs of Clear Creek, eleven miles to the southeast, immediately commenced an examination of this majestic pile of ruined walls, forming a mound two hundred and eighty feet in length by one hundred feet in width, having an average depth of seven or eight feet. The walls are now standing to that height, the lower rooms being filled with the *débris* of the fallen upper stories. The building had been destroyed by fire, three layers of charcoal in the rub-

FIG. 13.—METATE AND GRINDING-STONE FROM CASA GRANDE OF THE MIDDLE VERDE, FIVE MILES NORTH OF FORT VERDE.

bish corresponding to the roof and ceilings, which were evidently constructed of wood, reeds, and grass. Nearly all the inflammable materials had been destroyed, while many bone implements, and even some of stone, had been cracked and charred by the fire; and the greater part of the pottery, of which a large quantity was unearthed, had been broken by the fallen walls.

The labor of removing the *débris* from the rooms proved rather slow and difficult. As most of the pottery and implements

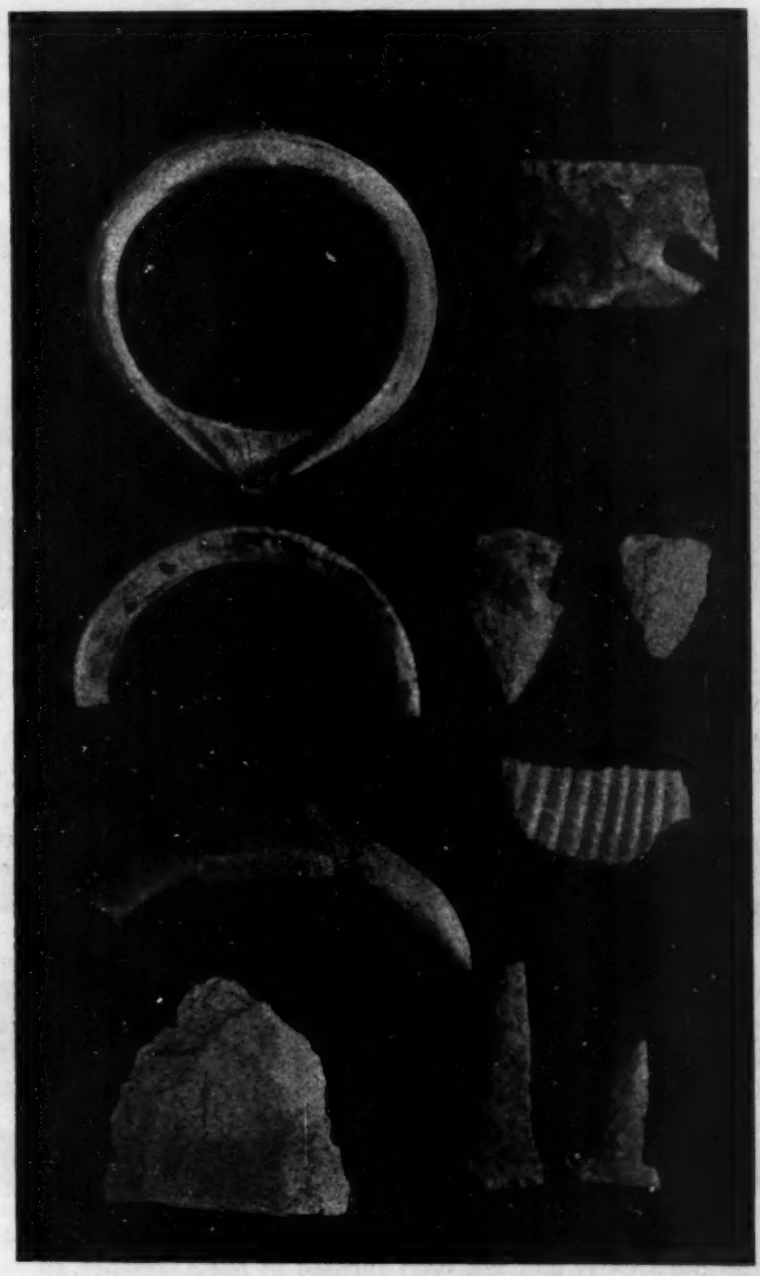


FIG. 14.—SHELL ORNAMENTS, ARROW-POINTS, AND STONE FROM A WAR-CLUB, FROM VARIOUS PARTS OF THE VERDE VALLEY.

were found upon the ground floor, the excitement of the quest increased proportionately as the bottom was approached. The standing walls were found to be from one and a half to three

and a half feet in thickness, sometimes plastered on the inside. The upper walls were doubtless of adobe, as the ruined pile contains a large quantity of that material. There is a natural stone-quarry in the rear of the buildings.

The rooms were spacious and the floors smoothly plastered. Beneath them were found vaults, plastered within, containing

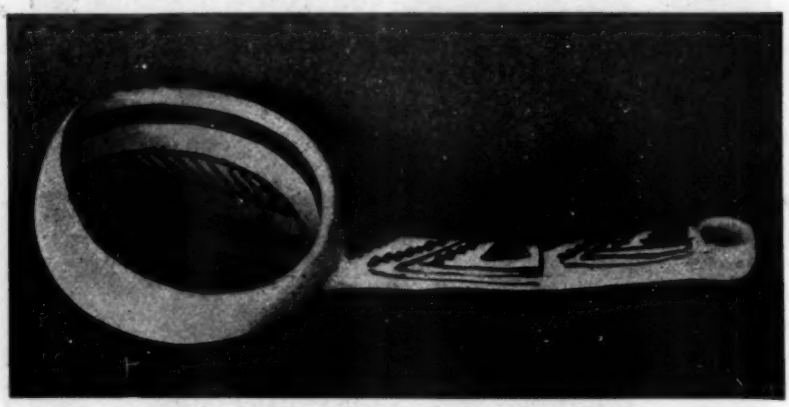


FIG. 15.—LADLE FROM RUINS NEAR THE VERDE RIVER.

human skeletons. In one room, ranged along two sides, close to the substantial partition walls, were tombs devoted exclusively to the sepulture of infants and children. The vaults were covered with large, flat stones, some of which were painted red. In one of them an *olla* was found, with the skeleton of an infant. The

FIG. 16.—ANCIENT POTTERY FROM THE VERDE VALLEY.

bodies apparently had not been incased in burial clothes, as was the case with those found in the burial caves of Clear Creek, as well as some of the adult skeletons exhumed from other parts of this building.

This *casa* proved quite productive in mineral and bone material, but most of the more perishable articles had been destroyed.

Of stone implements, the *metates*, used for grinding maize, form an exceedingly interesting set of specimens, exhibiting considerable variation in size and form. The greater number were of the hard, porous, gray scoria known as *malpais*, a material well adapted for grinding. Others were hewn out of sandstone, varying in color from red to creamy white. The manner in which they are fashioned with no better tool than another stone speaks in eloquent praise of the skill and indefatigable patience of these aboriginal workmen. A series of these primitive stone mills may be seen in the writer's collection at the American Museum. Grooved stone axes and hatchets were numerous, and likewise exhibit an unusually wide range of variation in size, shape, material, and workmanship. Several of them are, in form and finish, scarcely inferior to the modern articles. Some of the picks and hammers were also models of the handicraft of the stone age. Not the least interesting were stone wedges (doubtless intended for splitting timbers) and agricultural tools. There was also a large assortment of stone knives, resembling in shape the chopping-knife of modern housewives. Heavy malls, pipes of lava, whetstones, polishing-stones, and other implements whose use is not apparent, were obtained, besides mortars and pestles, stone vessels, and plates or platters of volcanic rock. Besides such articles of domestic use, there were the implements of warfare and the chase, including rounded stone hammers, mostly of sandstone and scoria, grooved for attachment to a handle by means of a hide thong; also grooved stones used in arrow-making, spear-heads and arrow-points of obsidian or agate, and flints from the war-club (*maquahuitl*).

Pigments—red, blue, gray, and black—were found; also a heavy, black powder, and the usual chipped pieces of obsidian (volcanic glass) and agate, together with ornamental pebbles, etc. Nor were ornaments lacking, such as amulets of shells and rings of bone and shell. Several heavy pieces of obsidian, which were probably transported from New Mexico, were doubtless kept in stock for the manufacture of knives and weapons. A heavy block of red catlinite, or "pipe-stone," of which small fetiches found in several localities were made, extends the commerce of this people to the region of the Upper Missouri, where the only known quarries of this material exist; and sea-shells, doubtless from the Pacific, are of equal interest, as showing the extent of traffic to the westward.

In several rooms large earthenware vessels were uncovered, which, although broken, were still held in position by the pressure of their contents and the earth surrounding them; fine rootlets also penetrated the cracks and formed a meshwork serving to hold them together. The largest were of coarse material and

had a capacity of about thirty gallons. Some of the smaller pieces were unbroken, and, although unglazed, were smoothly finished and decorated in colored patterns with rare taste. There were ladles or dippers, shallow saucers, graceful *ollas*, and vases displaying much artistic feeling in their conception and execution. One room appeared to have served as a store-room for earthenware utensils, some of which were found in nests, contained one within another, the smaller specimen measuring but one and one fourth inches in diameter. A few perforated discs of pottery, resembling wooden ones from cliff and cave dwellings, were noted.

Numerous tools of bone, chiefly such as were employed in the manufacture of ropes, neatly carved from the bones of deer or antelope, were among the relics found. Various food substances were examined, including bones, teeth, or horns (usually charred by fire) of elk, mule-deer, antelope, beaver, spermophile, pouched gopher, wood-rat, muskrat, mice, cotton-tail and jack-rabbit, turkey, serpent, turtle, and fish. A sandal of yucca, differing in design from that taken from the wall of Montezuma's Castle, and several pieces of human scalps, complete the list of relics from this *casa*.

There are many ruins of the class just described in the Verde region, as indicated on the accompanying map. Among them are several conspicuously perched on the summits of high, isolated, flat-topped buttes on the Rio Verde and on Oak, Beaver, and other tributary creeks; others are built on the precipitous edges of table-lands bordering cañons in which streams flow; while some occupy lower positions in the valleys. It would appear, from the location of some of these *casas grandes*, that the water supply has diminished or otherwise greatly altered since they were occupied, as there is now no water to be found within several miles of them. Cisterns were doubtless utilized, but must have proved inadequate to supply the needs of so large a population.

These pueblos frequently inclosed an open square or court. There is such a one on Oak Creek, built on a bluff butte, level on the top, which is one hundred and twenty-five feet above the surrounding *mesa*. The building is subrectangular in shape, conforming to that of the summit of the butte, the sides of which are precipitous. Other villages, perhaps less prosperous on account of their inferior advantages for agriculture, are to be seen in many localities, which were evidently but one story high. Such is the case with a pueblo built on the point of a *mesa* east of the Lower Verde settlement.

Furnaces, probably used for firing pottery, were discovered in some of these ruins. There is a very perfectly preserved one in a ruin on the right bank of Oak Creek, close to its junction with the Verde River, having walls standing to the height of fifteen to twenty feet.

Large pits are often seen in the vicinity of *casas*, whence the material used in making mortar was taken. The mortar used is of excellent quality, resembling fire-brick.

In concluding this brief sketch of the ancient remains of the Verde Valley, I would remark that they still present the most inviting field for the researches of the student of American anthropology and the included sciences of archæology and ethnology. From a merely superficial examination of their works much information has been derived concerning these remarkable cultures of our southwestern territory. In order that our knowledge of them may become as comprehensive as the material procurable for study will permit, it is desirable that a systematic exploration of these ruins be undertaken at once, either through private enterprise or by some one of the educational institutions of our country, before the treasures contained in them become scattered through the curiosity of unscientific relic-seekers. The writer's experience proves that an enormous mass of information and a large collection of valuable specimens would result from such an examination. Once possessed of these collected facts, it remains but to construct them by synthesis into a positive knowledge of much that relates to these people, than whom none are more interesting to the American anthropologist.

THE "EARTHLY TABERNACLE."

By OLIVE THORNE MILLER.

HOW to dispose of the earthly tabernacle after the spirit departs has always been a question of importance to the living. Some of the most imposing buildings in the world have been tombs; the pyramids of Egypt, and the Taj Mahal, that "dream in marble," will occur to every one. The widely prevalent notion that the dead require the conveniences needed in life, has preserved to us many relics of nations passed away, and to the habit of lavishing ornament upon places of burial we owe some of our finest specimens of early art. Even to this day, and in this Christian country, we attach an importance to the place and the manner of burial that seems hardly consistent with our professed belief that, in the words of the poet—

> "What the women lave
> For the last sleep of the grave,
> Is a tent that I am quitting;
> Is a garment no more fitting;
> Is a cage, from which at last
> Like a bird my soul hath passed."

The sentiment, however, did not begin nor does it end with us. So far back as we find traces of man upon earth, so far also do we discover signs of his treatment of the empty "cage"; and down to this year of grace 1890 the customs of humanity are as varied, as curious, and as interesting as at any period in the world's history.

In glancing over the subject, we find a noteworthy fact, that, whether the "garment no more fitting" be buried or burned, mummified, cast away, or eaten, some part of it is in almost every case preserved. With many peoples the chosen relic is the skull, which in Australia is made into a drinking-cup and kept for a memento as well as a common convenience by the next of kin; in some parts of Polynesia the skull of the "dear departed" is hung around the neck of a widow by a cord, and worn during the rest of her life; and in one of the Kingsmill Islands it is oiled, decorated with flowers, and daily presented with food.

In some races the affectionate care of the survivors extends to all the bones, which are distributed among the friends, each one of whom mourns over his one bone as if it were the whole body. Again, they are arranged in various fanciful ways: tied in a bundle and painted red, by one tribe; packed in a basket decorated with beads with the skull for a lid, by another; hung from the roof, or placed in an urn, or wrapped in bark and carried with the tribe; or, finally, painted in stripes and dried in smoke.

Alexander the Great—as history tells us—was preserved in honey, and some of the royal Britons in wax; but the most famous embalmers, as we all know, were the Egyptians. Would they have taken so much pains, I wonder, if they had suspected they were preparing curios for the museums of impertinent nations yet unborn? Perhaps the most peculiar mode devised by man is the preservation of rich Thibetans in the form of cakes. The empty "hut," being reduced by fire to ashes, is mixed with wheat-flour and kneaded into cakes of graduated size, piled in a pyramid, and deposited in a small tower of suitable form.

Nearly all people cherish, in one way or another, the bones of their friends, and they may be conveniently divided into two great classes—those who take measures to dispose of the more perishable covering, and those who leave the work to the slower processes of Nature. Among the first named are some exceedingly strange customs: as that of the Caribs, who hang the empty case in water infested by extremely voracious little fishes, and in a few hours draw up the skeleton perfectly cleaned, paint it red, and hang it under the roof of the hut; and, perhaps even less agreeable, that not long ago in vogue among the Thibetans and others, of keeping a race of sacred dogs for the special business

of quickly disposing of the cast-off human garment; and, again, the habit of the ancient Persian, who invited wild beasts to the feast, and considered their speedy acceptance a special honor; most repulsive of all, some tribes of Tartars, and the Fans, an African people, who take upon themselves the delicate task of disposal—with pleasure, it is said. With this latter group must also be placed the ancient Irish and Briton, and many South American Indians. Most interesting of the practices of "living sepulchres" is that of the Parsees of India, whose famous Towers of Silence are well-arranged buildings where the necessary work is done quickly and unseen of men, by vultures "sent by God," as they say, and the bones preserved in one great central well together.

The most widely extended fashion of forcibly resolving the body into its elements is by burning, which has been in use almost from the beginning of man's life on this planet, and is to-day rapidly growing into favor with enlightened peoples. Before the advent of Christianity it was the nearly universal practice. The Greeks and Romans, the Etrurians, Hindoos, Siamese, Germans, Scandinavians, and Saxons, and many Indian tribes of the Western world, all burned their dead with more or less ceremony, and some of them do still. Certain Australians put the body in a hollow tree, and make of that a funeral pile; the Gualala of California burn the departed to prevent their becoming grizzly bears; and the Semels, another tribe, glorify their chiefs by great pyres heaped with finery and valuables, sometimes several hundred dollars' worth.

To the cremationists must be added many peoples of Asia, among whom the fashion is still in full vigor. Some races, both savage and civilized, sacrifice the living on the funeral pile, the victims being, of course, the helpless wives and servants. Most of them are merciful enough to strangle or otherwise kill the doomed ones, but it was reserved for the "mild and gentle Hindoo" to invent and carry out the most cruel and brutal custom on record.

Of the races who let Nature do the work at her leisure, perhaps the most striking are those who wall up the door and leave the deceased in possession, since this comes the nearest we can hope to get, to taking our riches with us. Such were the ancient Peruvian Incas, whose palaces were closed and deserted with all their treasures in them, although the dried and preserved body took its place with its ancestors in the Great Temple of the Sun, and the dying Eskimo left in his snow hut, with food and light at hand, free to depart when he chose.

Unique among men is one who saves his friends trouble by burying himself. The aged Australian, feeling death approach,

seeks out a hollow tree, climbs it, drops down inside, and is from that moment numbered among those who have "passed on."

Other methods are observed by the red men. Some of them are exposed to the winds of heaven, upon platforms raised on poles, as our own Dakotas, Blackfeet, Mandans, and some Sioux; others are placed in trees, like the Ahts of Vancouver's Island, where the height of the body indicates the social position of the departed; and not a few simply lay the cast-off "garment" on the bosom of its Mother Earth for the winds and storms to dispose of. In one place the body, in a canoe, is committed to the "mother of all things," the sea; and among the Hindoos it is often devoted to the sacred Ganges, lying on a platform with candles at the corners.

The largest number of civilized people, including all Christendom, bury in the earth, and, far less wise than the simple Indians whose ways we scorn, endeavor to keep as long as possible the "shell from which the pearl is gone" from its natural and much-to-be-desired fate, dispersal into the elements. This custom of burial arose partly from the desire of Christians to imitate the dead Christ, who—as a Jew—was buried; partly from a belief in the resurrection of the body, and also influenced, no doubt, by the difficulty during the early persecutions of performing Christian rites at a burning which must necessarily be public.

The curious and peculiar manners connected with burial in the earth are almost numberless, and edifying in the extreme. The position differs: some sit as in life, and others are held standing, though most lie naturally. The direction of the head varies. Many of our Indians turn the face to the west, toward their "happy land"; a few turn to the east. The dead Japanese heads toward the north, for which reason the living never sleep that way, and, to avoid the chance of it, carry a compass, or mark its points on their houses. The Bongos of Africa carry the distinctions of sex into the grave, and set the faces of men to the north and of women to the south; while the Niam-Niam, a neighboring tribe, consider the east the point of honor, and the west good enough for the weaker sex. Quaintest of all is the burial of an aged clergyman, a life-long pastor in an old-fashioned village on Long Island, who is laid with his feet toward his congregation, so that on the last day, when the trump shall sound, he may rise facing them as usual, and prepared to lead them, a united flock—*his* flock—into the Kingdom.

Urn burial has attracted much attention since it was brought prominently before the world at the Vienna Exposition some fifteen years ago. There had been a spasmodic revival of interest in this manner of disposal of the body both in France and Italy, but nothing of importance till this exposition. A warm convert,

Sir Henry Thompson, of England, wrote enthusiastic articles for the leading journals, and an earnest controversy was kept up for some time. The result has been discussion all over Europe and America, the establishment of cremation societies, and the building of crematories, for the new method differs greatly from the ancient fashion of burning on funeral pyres. The pyre, however, is still in use in India and other parts of the world, reaching its utmost extravagance in Siam, where bodies of the royal family are burned in gorgeous and elaborate temples built of wood and inflammable materials, but adorned and decorated, painted and gilded, to exactly represent their finest architecture.

There are many things to commend cremation aside from the pretty Indian fancy that fire, the purifier, completes the deliverance of the soul from its long-time prison of flesh, and by the smoke and ascending heat forms a path on which the spirit ascends to its home in the skies, or, as one tribe has it, the soft, warm chariot conveys the released and purified soul toward the sun.

We, of course, scoff at this, but there are potent arguments that should influence even our profound wisdom—sanitary reasons, the health of the living; economical reasons, the much-reduced expense; even sentimental reasons, the possibility of preserving the remains from desecrating touch. Most powerful of all in its favor is the prevention of premature burial. All these are on the side of cremation, and against it is but one—sentiment. It seems more beautiful to lay our friends to rest, softly pillowed, shrouded in satin, inclosed in rose-wood, covered with flowers, and of anything beyond we refuse to think. We erect the imposing marble, set out the blossoming plant, and carry flowers to the spot. The cemetery appeals more strongly to the sentiment than does the crematory. I find no fault with sentiment, but I say it will more appropriately cling around an urn containing the pure ashes of what was once a loved form than about the unmentionable and unimaginable horrors covered by our flowers.

Moreover, it is to be regretted that we can not rise to the height of Christian philosophy attained by one we call "heathen," and embodied in a poem, some lines of which are quoted above, with a few more of which I will close:

> "Loving friends! be wise, and dry
> Straightway every weeping eye.
> What ye lift upon the bier
> Is not worth a single tear.
> . . . . . .
> Cease your tears, and let it lie;
> It *was* mine, it is not I."

LIQUOR LAWS NOT SUMPTUARY.

By Rev. GEORGE F. MAGOUN, D. D.,
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THE recent article * of William A. Hammond, M. D., on Sumptuary Laws and their Social Influence consists of two parts—(1) an attempt to confound laws prohibiting the common sale of alcoholic beverages with obsolete "sumptuary" legislation, and (2) certain criticisms in the same strain upon such laws in Iowa and Minnesota, and upon the New York and Michigan laws against the selling of cigarettes to minors. As no pretense is made of showing that the latter are "sumptuary," or that it is a tendency to luxury and expense which makes them a dead letter in the city of New York and elsewhere, they may be at once dismissed from consideration.† A long-time resident of Iowa has something to say in defense of the stigmatized statutes of his adopted State.

The sweeping assertion of Dr. Hammond is in the following terms:

"The laws which several States have enacted relative to the manufacture and sale of alcoholic liquors are true sumptuary laws, notwithstanding the fact that it is claimed by their adherents that they are measures which every independent State having a regard for the welfare of society is in duty bound to enforce." The first example given to sustain this is a law of Iowa, referred to (after descriptions of the sumptuary laws proper of Sparta, Rome, and England) thus:

"In our own country the experiment has been tried with as much thoroughness and with practically as little result as has attended the attempt by other nations" [i. e., to forbid the people

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* Popular Science Monthly for May, pp. 33–40.

† The following is credited in the public journals to Science: "In an experimental observation of thirty-eight boys, of all classes of society and of average health, who had been using tobacco for a period ranging from two months to two years, twenty-seven showed severe injury to the constitution and insufficient growth; thirty-two showed the existence of irregularity of the heart's action, disordered stomachs, coughs, and a craving for alcohol; thirteen had intermittency of the pulse, and one had consumption. After they had abandoned the use of tobacco, within six months' time one half were free from all their former symptoms, and the remainder had recovered by the end of the year."

It is certainly supposable that intelligent law-makers could enact a statute to prevent the sale of tobacco to boys from a humane and public-spirited motive without thinking of the pennies saved to the boys; and if the enforcement of the law saved their pennies, so much the better for the boys and no worse for the law. Any good citizen is therefore at liberty to hope for such a law and such enforcement as prevents the sale. As to these and a more recent law in New York, it might be instructive to know from the legislators whether they really enacted them from "sumptuary" considerations.

"to wear, to eat, and to drink what they please"]. "As early as the year 1639 we have the prototype of that curious law enacted a few years ago in the State of Iowa, which prohibits one person from inviting another to take a drink, or treating, as it is called."

A citation is then made from the records of the colony of Massachusetts of a statute for which four reasons are alleged, one of them being "much waste to the good creatures." This, and this alone, is a sumptuary reason. But the law cited—if it be one—is not simply and distinctively sumptuary, though such laws were passed by that and other colonies. For example, Virginia, in 1662, enacted the following:

"An Act* prohibiting the importation of unnecessary Commodities. *Whereas*, the low price of tobacco will hardly supply the urging and pressing necessities of the country, etc., . . . Be it *enacted* that no strong drink of what sort soever, nor silke stuffe in garments or in peeces (except for whoods and scarfes), nor silver or gold lace, nor bone lace of silk or thread, nor ribbands wrought with silver or gold in them, shall be brought into this country to sell, after the first of February next; under penalty of confiscation," etc.

So Massachusetts enacted in 1634 as follows:

"The Court, taking into consideration the greate, superfluous, and unnecessary expences occasioned by reason of some newe and immodest fashions, as also the ordinary weareing of silver, golde, and silke laces, girdles, hatbands, etc., hath therefore ordered that noe person, either man or woman, shall hereafter make or buy any apparell, either woollen, silke, or linnen, with any lace on it, silver, golde, silke or threed, under the penalty of forfeiture," etc. Subsequent provisions forbid any one to make "slashed cloathes," but allowed men and women "to weare out such apparell as they are nowe provided of (except the immoderate greate sleeves, rayles, longe-wings, etc.)." In 1636 a law was passed against making or selling any bone lace. In 1641 the General Court, noting excesses prevailing against enactment, ordered the constables of every town to see to its enforcement.†

Upon the face of them these are characteristically, simply, and only sumptuary prohibitions. Their one, immediate, and sole object is the prevention of private waste and expense. So Dr. Johnson, a century and a half ago, defined this class of statutes: "SUMPTUARY [*sumptuarius*, Lat.]: Relating to expense; regulating the cost of life." He quotes Bacon, a century

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*Dr. J. Hammond Trumbull says: "This law is crossed with a pen on the MS. record: Jefferson '*conjectured* it was negatived by the Governor.'"

† That notorious liar, Rev. Samuel Peters, in his Blue Laws declares the penalty in Connecticut for wearing lace was "at £300 estate"—about as true history as the rest of his writings.

earlier, on "removing want and poverty" through "the repressing of waste and excess by sumptuary laws." The definition has never changed down to our day. (Cf. Webster, Worcester, and others.) So Skeat's Etymological Dictionary—"relating to expenses (L.). It is rather Englished from Latin, *sumptuarius*, belonging to expenses, than borrowed from the French. Formed from crude form of *sumptus*, expense, cost" [so "sumptuous"]. It is therefore simply evidence of lack of discrimination to call any law a sumptuary one whose object is not the prevention of cost, expense, and waste. One might as correctly pronounce the proclamations in the colony of New York against any but the Dutch Reformed worship (1656, 1662), or those of Virginia against absence from the Episcopal service (1623, 1652), or those of Maryland against blasphemy and denying the Trinity, and using anything in public worship save the Book of Common Prayer (1649, 1700), sumptuary laws as those of to-day against the traffic in intoxicating beverages. They have nothing in common. The colony of Maryland provided that "every ordinary keeper that shall demand or take above 10 lbs. of tobacco for a gallon of small beer, 20 lbs. of tobacco for a gallon of strong beer, 4 lbs. for a lodging, 12 lbs. for a peck of Indian corn or oats, 6 lbs. for a night's grass for a horse, 10 lbs. for a night's hay or straw, shall forfeit for every such offense 500 lbs. of tobacco." It would be an unnecessary blunder to assert that *this* had nothing to do with restraining what was deemed undue cost of living and traveling. But Maryland enacted the same year (1699) that "No inhabitant of this Province shall sell without license any cider, quince drink, or other strong liquor, to be drunk in his or her house, upon penalty of 1,000 lbs. of tobacco for every conviction." Is the reason and principle of this the same with the reason and principle of measures adopted to keep down prices, such as several colonies adopted—e. g., that just cited, restraining innkeepers from overcharges? Both are prohibitory. But is the restraint of *unlicensed* liquor-selling fitted to lower the prices of intoxicating drinks, or—other things being equal—does the cost of a license to sell tend to raise prices? If, then, this latter Maryland law could not have been sumptuary, has not the free sale of intoxicants been repressed, whether by license or prohibition, for other reasons—viz., those of public policy—that is to say, the duty of "every independent State" to have "a regard for the welfare of society"? But this is just what Dr. Hammond takes it upon himself to say has *not* influenced the legislation of certain great commonwealths, East and West, forbidding the sale and manufacture of alcoholic beverages. Is it quite sure that he knows their ends and motives better than they know them themselves?

The point will be made still clearer—if this is possible—by

noting the ancient colonial legislation against liquor-selling, and judgments against drunkenness. 1630, Massachusetts: "It is ordered that all Rich: Cloughe's strong water shall presently be seazed upon, for his selling greate quantytie thereof to severall men's servants, *which was the occasion of much disorder, drunckenes, and misdemeanour.*" If we are to believe Dr. Hammond, "the Massachusetts Court of Assistants and General Court," who passed this order, either did not know why they passed it, or deliberately falsify the record, giving certain fictitious reasons for their action in place of the one constant, true one for all such action, known to Dr. Hammond now, but absent from the history of the case. This is reconstructing history with a vengeance. For our own part, we prefer to believe the Massachusetts actors and witnesses themselves. 1632: "It is ordered that the remainder of Mr. Allen's stronge water, being estimated about two gallands, shall be delivered into the hands of the deacons of Dorchester, for the benefit of the poore there, *for his selling of it dyvers tymes to such as were drunke with it,* hee knowing thereof." Neither the recording officer, nor the Dorchester deacons, nor the General Court, seem to have known that the real reason here was that those who made themselves drunk could not afford the expense!

Dr. Hammond gives a couple of instances of colonial punishment of drunkenness. Here are others. 1633. Massachusetts: Robert Coles fined £10 for "abusing himself shamefully with drink," and enjoined to stand with "A DRUNKARD" in great letters on a white sheet on his back, "soe longe as the Court thinks meete." [The penalties for repetition next year—disfranchisement, etc.—referred to by Dr. Hammond, were remitted, May, 1634, on submission and testimony of good behavior.] T. Hawkins and John Vauhan fined 20*s* for a similar offense and selling "strong water, contrary to an order of Court." In 1643 and 1650 the colony made the harboring of drunkards penal. But there is not the slightest evidence that the proceedings in these cases were for sumptuary reasons. 1639: Wm. C—— was fined 40*s*. "for misdemeanor in drinking, and corporal punishment remitted upon his promise to avoid such occasions." The same year, in New Haven, John Jenner, "accused of being drunk, was acquitted, it appearing to be of infirmity, and occasioned by the extremity of the cold." "Mr. Molenour, accused, but not clearly proved, was respited." It could hardly have been the object in these cases to prevent the expenditure for the liquor, or to dictate what the persons concerned should or should not drink! Nor when Thomas Frankland was punished "for drinking strong liquors to excess and entertaining disorderly persons into his cellar to drinking meetings." The First Code of Connecticut, 1650, mentions "divers abuses that

fall out by several persons that sell wine and strong water, as well in vessels on the river as also in several houses"; and the Orders of the General Court of Massachusetts, 1643, forbidding continuance "above half an hour at a time in any common victualing-house" for the purpose of tippling, justifies this "for the preventing that great abuse which is creeping in by excess in wine and strong waters." Were these bodies entirely mistaken in supposing they were actuated by "a regard for the welfare of society" instead of sumptuary considerations? On the other hand, in 1637 the record "it hath appeared unto this Court (Mass.), upon many sad complaints, that much drunkenness, *waste of the good creatures of God*, mispence of precious time, and other disorders have frequently fallen out in the inns and common victualing-houses," includes sumptuary considerations, with others (as did the prohibition two years later, cited by Dr. Hammond), as reasons for regulating the price of liquors and meals at inns.* Need any one confound this with laws simply to prevent drunkenness? Perhaps the confounding of these two different things has arisen from the mendacious forgery of Peters (Blue Laws, 26). "A drunkard shall have a master appointed by the selectmen, who are to debar him from the liberty of buying and selling" (published in 1781). Under the head of "Innkeepers," etc., the New Haven Laws and the First Connecticut Code provide penalties, ten shillings or less, for drunken behavior, etc., at inns, and for the "disorder, quarreling, or disturbance" resulting. And here the colonies—the Northern ones, for those of the South seem to have laid no such restriction—followed the laws of England; for example (4 James I, ch. 5) "Every person convicted of drunkenness shall forfeit, for every such offense, five shillings; and if unable to pay, shall be set in the stocks six hours." The law of Minnesota against drunkenness may be more severe in amount of penalty—"from ten to forty dollars for the first offense"—but is no more "sumptuary" than the old statute of James I—no more so than the French and German military prohibition of tobacco. Is it the expenditure made by the soldiers for cigars or cigarettes that these army orders are intended to prevent, or the unfitting of their nerves and muscles for military service? What an absurd bugbear the word "sumptuary" is, to be sure!

We can now readily see that the law of Iowa, twice referred to by Dr. Hammond, is not a sumptuary law at all; did not have for its prototype the partly sumptuary colonial enactment of Massachusetts of 1639, or the previous one of 1636; and is intemper-

* In an age when prices, wages, and expenses were regulated frequently by law, mixed regulations of this kind would naturally at times be passed; at present, when we have nothing of the kind, they would not be, and those of a totally different character can not be made such by construction or assertion. Cf. Maryland law, 1699, above.

ately stigmatized as "the height of human folly." One would think from his description—"it is made a penal offense for one person to ask another to take a drink"—that even in the "castle" of one's own home one can not do this in any circumstances—so eager are the Iowa law-makers to forbid the people "to wear, to eat, and to drink what they please." Passing the flippant tone in which it is asserted that a man who, "in the sanctity of his own house, gets quietly drunk and goes to bed," "has injured no living being but himself," it is to be said that there is nothing whatever in the penal features of the prohibitory statutes of Iowa that has anything to do with the "sideboard" in a private house.

It strikes one rather oddly, on the score of logical concinnity, that the prevention of a man's being "treated" to liquors, without any expense to himself, should be argued against as a "sumptuary" measure, whether the giving away of the liquors is done in a saloon or a parlor. A prejudice in favor of the free use and sale of intoxicants may indeed prevent one from seeing a ludicrous fallacy here.

A prohibition of giving away liquors to Indians, minors, and persons who are already intoxicated is quite an old affair in the Code of Iowa. It stands under the title "Offenses against Public Policy." To persons who have lived in States or Territories where Indians still linger it will be very clear at once what "public policy" has to do with it, and that the sumptuary question has nothing. A general provision years since against evasions required courts and juries to construe the whole chapter concerning intoxicating liquors "so as to cover the act of giving as well as selling by persons not authorized." Is not this according to public policy, anyway? Artful sales by pharmacists for other purposes than medicine were carefully provided against. Selling to voters within a mile of the polls during an election was forbidden, and the purity of elections further protected by forbidding to *give* them any intoxicants, including ale, wine, and beer. Is this any more sumptuary than making the sale unlawful within three miles of the State Agricultural College (save for sacramental, mechanical, medical, or culinary purposes), or within a hundred and sixty rods of any agricultural fair? On the other hand, all this was so far from interfering with the right of the people to drink what they please that the Iowa Supreme Court had decided that the act of giving is not in itself unlawful, that the keeping of liquors without intent to sell unlawfully is not affected, nor the character of liquors as property. "The statute," said Judge Beck, of the Supreme Court, in one case, "does not forbid the simple act of giving when no consideration, reward, or payment was given or promised, and none expected, and which was not intended as a subterfuge to conceal unlawful sales and evade

the penalties of the law." These things are recited to show the spirit of the legislators and judiciary of a prominent prohibition State. On these principles later enactments are founded.

But evasions of the law and the making of drunkards thereby, continuing to be found in a state of intoxication (in the presence of others, of course, not quietly sleeping off a debauch alone "in the sanctity of [one's] own house"), was more recently made a misdemeanor, punishable with ten dollars fine or thirty days in the county jail. That the object was not to prevent the drunken person's loss ("injuring no living being but himself"—were this in ordinary cases possible)—is evident from the remission of the penalty on his informing against the vender who has defied law and injured the welfare of society; so little concern has the prohibition for cost or waste on the part of the person buying and getting drunk. To prevent another evasion, it was also in recent years made a misdemeanor to keep a club-room "in which intoxicating liquors are received or kept for the purpose of use, gift, barter, or for distribution or division among the members of any club or association by any means whatever." The object of this must be clearly beyond the power of any one ever so prejudiced to misrepresent. In keeping with this, the buying by a third person to treat an intoxicated person made the seller, not the third person who met the expense, liable at law.* Also, the interpretation of the law was made to cover "alcohol, ale, wine, beer, spirituous, vinous, and malt liquors, and all intoxicating liquors whatever," their evil effects—and not their cost, or the waste of money upon them—being alone in view. Still later, in 1888, the Iowa General Assembly, to prevent other evasions still practiced with perverse ingenuity and against the weal of the commonwealth, enacted what, I suppose, has called out the effort of Dr. Hammond to stigmatize all our prohibitory legislation as sumptuary. It was this:

"After this act takes effect no person shall manufacture for

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* Some anti-prohibitionists, for example, the present Democratic anti-prohibition Governor of Iowa—the only State officer of this description, and the first one elected for about a generation—favor summary, or even severe, dealing with drunken persons. Prohibitionists agree with them in this substantially, and in not interfering with their personal right to buy, while they differ with them as to repressing the sale by others openly, which is the chief source of drunkenness.

The public prints within a few days contain the following, which an experienced army surgeon will hardly pronounce "sumptuary"!

"The military commission of the Austrian army have established a law that the offense of intoxication should be punished the first time by a public reprimand. The second offense by several days' imprisonment in the guard-house. The third offense is evidence that the victim is suffering from a chronic disease, and he is placed under constant surveillance. His pay is taken out of his hands, and every means used to prevent him from getting money to secure spirits."

sale, *give away*, exchange, barter, or dispense any intoxicating liquor for any purpose whatever, otherwise than as provided in this act. Persons holding permits as herein provided shall be authorized to sell and dispense intoxicating liquors for pharmaceutical and medicinal purposes, and wine for sacramental purposes, but for no other purposes whatever."

I hope the terms of this statute make it sufficiently evident that the men who made and passed it were absolutely in downright earnest to suppress the wretched traffic in drunkard-making beverages, and I have not a word of apology to offer for them. This measure, to use Cromwellian phraseology, is one of "root-and-branch" extermination of a sore and fearful evil. But along with it should go the statement that this is but half of their legislation on the subject, the other half—known as the "Pharmacy Act"—being permissive of the sale of the same intoxicants, for the lawful purposes above named, by pharmacists, under restrictions. Some of these were by the last General Assembly relaxed, with no effect, however, upon the other half of the law, prohibiting sales of beverages by other persons. Step by step that has been allowed by law and that forbidden which long and disastrous experience showed might or must be. I am authorized to declare that neither this nor any other statute of Iowa is "sumptuary" in character or intent. I do not claim that all of them are perfect for their ends, but only that—a simple fact—this is in no instance among their ends. The giving away of means of intoxication included in the last recited statute (22 Gen. Assembly, chap. 71, § 1) is forbidden simply and solely to prevent evasions. Doubtless it will be condemned by those who are willing the risk of promoting drunkenness should be incurred by a liquor traffic more or less free; but, after this patient exhibition of authoritative facts, it should be forever impossible for any intelligent and candid man to stigmatize it as "sumptuary."*

After this refutation of its main contention, minor points, made in the same spirit in the article here criticised, hardly require notice. That "*no one* is safe under such a law" as that of Minnesota from arrest and penalty on the charge of his being drunk, will call out a smile among the sober people of that good State. That every law of this tenor is quite or "almost a dead letter" is —within the ordinary and daily observation of citizens in States where they are in force—absolutely contrary to fact. At the time of this writing the retail of drinks manufactured in other States is suddenly and notoriously increasing under the "original packages" decision of the Supreme Court of the United States. This

* No laws against the *evasion* of a statute can possibly be "sumptuary," unless the original statute is such, which in this case is not, as we have shown at large.

unhappy change is proof plenary of the wide departure from truth, among other things, of assertions that sales were all the while going on, which have been suppressed and only now resumed. Such assertions have come chiefly from persons residing elsewhere, in the face of the testimony officially given by the Governor of Iowa, judges, and other State officers. That there are other offenses against society unpunished and unforbidden is nothing to the purpose as to why liquor-selling is forbidden. If advocates of temperance argue, in the way of philanthropic moral suasion, that "those who indulge in alcoholic liquors or tobacco spend money which could otherwise be more profitably used," it is just what they should do; but in not even the smallest measure does it go to prove that laws devised for other objects were intended, after all, though their authors do not know it, to prevent this spending of money. If they have this effect incidentally, so much the better for the money spenders and no worse for the law. Any good "social influence" of a Code of Criminal Procedure which provides penalties for such "Offences against Public Policy" Dr. Hammond is precluded from recognizing by his assertion that they are null and void. What, then—should such offenses go scot free? What crimes, then, should be punished at all? His boast of evading the law of Rhode Island "at a prominent hotel" by a trick—be it professional or unprofessional—with impunity* is certainly very good evidence that the law did not prohibit the private act of drinking, but the public act of selling. Does any law anywhere interfere with liberty of buying, save in the harangues of Personal Liberty Leagues? Prohibitionists everywhere disclaim such interference, but claim the right of "every independent State" to suppress the common and public sale of anything deemed detrimental to "the welfare of society." Any argument against this has little weight, save with those who subordinate this "welfare" to personal convenience, and, moreover, goes too far in that it sanctions the open sale of powder and dynamite by anybody who sets up his "personal liberty" in this regard. The real objection of the free-sale advocates is to the actual obstacle "to get any kind of liquor a person wants" in any kind of "packages," and "as many more on the same terms," i. e., by some unlawful evasion—which obstacle is denied in the same breath to exist! One horn or the other of the dilemma the advocates of free sale should now choose, after so long playing pendulum between the one and the other.

It is not a little surprising that under the head of "social influence" a stronger denial than this self-contradictory one is not made. It is here suggested gratuitously to the liquor interest.

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* Popular Science Monthly, May, p. 38.

When its advocates assert that those who are determined to have intoxicating beverages will get them, by hook and by crook, spite of all safeguards with which the public weal surrounds itself (an assertion equally strong against powder and dynamite laws, etc., and equally weak), they almost say, but not quite, that those are least prevented from buying who most need to be. This is quite true; but it is an inevitable incident, not of law, but of universal human perversity. There is no help for it save by making men perfect at once. In a prohibition State moderate drinkers will refrain from buying, while abandoned drunkards will buy through the unmanliest, the meanest, and basest expedients. So much the better for the moderate drinkers, anyway and at least, and no worse for the law. A multitude of such persons in Iowa and Kansas to-day praise the laws that protect them from their lower selves. Even our German fellow-citizens, with habits and prejudices brought from "Fatherland," very numerously do the same. But this alone is not the extent of public good secured. Hardened criminals of any sort, whom no law can reach, would soon disappear from natural causes were not their ranks replenished. The drunkards who will lie and cheat, and generally degrade themselves for the means to get drunk, in like manner would soon die out if not reformed. But they are replaced by new recruits from *the moderate drinkers alone;* and if these largely respect prohibitory laws, though the unhappy beings whom they are on the way to join do not, there will ere long be few to break these laws at all. Unwittingly, the assertion of liquor men that such laws are a "dead letter," so far as it is true—and this is far less than is asserted—only suggests another defense of these laws from their widely experienced "social influence."

One sometimes wonders why license laws, as well as prohibitory ones, are not denounced as "sumptuary"! The fact is, that their natural tendency is to increase the expense of both intemperance and moderate drinking—the liquor-vender charging more for what he sells to cover *his* expense for a license. This might in some small measure lessen buying, and expense with it, on the part of those who can least afford to buy. Would any one pretend that this is the object of license laws, rather than to balance the notorious injury done by the traffic to the State, by putting the license fees into its treasury? There is one obvious and nearer reason for not misrepresenting license laws as "sumptuary," viz., that however thoroughly enforced they may be, the means of securing the effects of intoxicating drinks, moderate or immoderate, are openly obtainable. Under prohibition, as well enforced, they are not.

It is to be noted that, if the Iowa Legislature had *not* provided by further legislation against evasions of its statutes (through

such subterfuges as club-room arrangements, treating, exchange, barter, etc.), there might be some pretense that it is expense to the drinker which the Iowa law originally intended to prevent. But this can not be the object when the drinker is at no expense. And so the very statute preventing evasions assailed by Dr. Hammond goes to overthrow his contention, since the reason for preventing them can not be "sumptuary." There is an old saying about hoisting one's self with "his own petard."

THE MIGRATION OF SYMBOLS.

By the COUNT GOBLET D'ALVIELLA.

II.

SYMBOLS may differ in aspect and yet be connected with one another by a more or less direct affiliation. This thought leads us to examine the causes which may change the forms of symbolical representations. There is first a tendency to reduce or simplify the figure, in order to confine it to a smaller space or to diminish the labor of the artist—especially when the figure is complicated and frequently used. In all the systems of writing in which the characters began as hieroglyphics, we have only to scratch the letter to find the hieroglyphic symbol. Thus our vowel A was originally the head of an ox, and that in its turn represented the whole animal, according to the popular rule that in symbols and sacrifices a part may stand for the whole. So, likewise, in the signs of the zodiac, the lion is simply represented by his tail. At other times, again, additions and embellishments are dictated by æsthetic considerations. That was the case with most of the symbols adopted by Greece, whose art, so strongly original, never adopted foreign types without impressing profound and felicitous modifications upon them.

The caduceus did not always present the classical form of two serpents symmetrically entwined around a winged rod. On the oldest monuments it is a stick the knotty head of which forks into two branches that curve round till they recross one another, then diverge and approach again, so as to form a figure 8 placed at the end of a rod and open at the top. The poems of Homer disclose to us an epoch still more remote, when a simple flowering rod with three leaves was attributed to Mercury. In seeking an explanation of these transformations, we suppose that the first in date was probably due to the influence of the Phœnicians, who left on their steles, especially in Libya, the representation of numerous caduceuses formed of a circle placed upon a stick and surmounted by a crescent. It is open to discussion whether the sec-

ond modification—which was justified after the event by the legend of Mercury throwing down his rod between two fighting serpents—reveals a symbolic intent, or is due, as most of the learned think, to a fancy of Greek art. But, in either case, the innovation made it possible for the caduceus to be preserved in modern symbolism to represent the two ever-present attributes of Mercury—Industry and Commerce. In like manner it has been perpetuated in India, where it was introduced by the Greeks, till our time; and M. Guimet observed numerous examples of it among the votive offerings in some of the Vishnuite temples. Nothing is lost in symbolism that is worthy to live and can be transformed.

Symbols are also subject to the law of the struggle for existence. It was artistic perfection that secured the longevity of the thunderbolt—another figure which was long believed to be of Hellenic origin. Nearly all peoples have represented the fire from the sky by an arm, sometimes also by a bird of strong and rapid flight. It was symbolized among the Chaldeans by a trident. Cylinders going back to the most ancient ages of Chaldean art exhibit a water-jet gushing from a trident which is held by the god of the sky or of the storm. The Assyrian artist who first, on the bas-reliefs of Nimroud or Malthaï, doubled the trident or transformed it into a trifid fascicle, docile to the refinements and elegancies of classic art, by that means secured for the ancient Mesopotamian symbol the advantage over all the other representations of thunder with which it could compete. The Greeks, like the other Indo-European nations, seem to have represented the storm-fire under the features of a bird of prey. When they received the Asiatic figure of the thunderbolt, they put it in the eagle's claws and made of it the scepter of Zeus, explaining the combination, after their habit, by the story of the eagle bringing thunder to Zeus when he was preparing for the war against the Titans. Latin Italy transmitted the thunderbolt to Gaul, where, in the last centuries of paganism, it alternated, on the Gallo-Roman monuments, with the two-headed hammer. It is also found on amulets of Germany, Scandinavia, and Brittany. In the East it penetrated to India, following Alexander, where it is found competing with other symbols having the same significance. Siva, who succeeded Zeus on the coins of the Indo-Scythian kings, after the light of Grecian civilization was extinguished in the Northeast and in India, holds in his hand sometimes the thunderbolt and sometimes the trident; and while the latter remains exclusively the arm of the god in the later imagery of the Hindoo sects, the thunderbolt found its way to the Buddhists, who carried it with their symbolism to China and Japan. It is still met under the form of the *dordj*, a little bronze instrument in the shape of a

double fascicle of six or eight arrows, which, held between the thumb and forefinger, is used by the lamas and bonzes in blessing the faithful and exorcising demons.

By the side of the improvements due to the aspirations of artists must be placed the deformations produced by the ignorance or unskillfulness of copyists. Sometimes a new type springs from these deteriorations to succeed the old one in somewhat the same manner as in the dissolving views, where the outlines of two pictures succeeding one another are confounded into an indistinct image which is neither one nor the other. The ansate cross of the Egyptians seems thus to have engendered certain types of the Ephesian Diana, with veiled face, arms half opened, and body inclosed in a sheath; as also the sacred triangle of the Semites, frequently surmounted by a disk and two horizontal bars, inspired in the Greeks, according to François Lenormant, representations of Harmony or of Aphrodite under the form of a cone crowned with a tiara and supplied with two rudimentary arms. As a counterpart to these metamorphoses changing a linear symbol into a representation of the human figure, may be cited some images sculptured on the paddles of the New-Irelanders, which were exhibited at the meeting of the British Association in 1872. There was revealed in them a series of deformations gradually changing a human face into a crescent couchant on the point of an arrow. Except for the presence of the intermediate forms, no one would have inferred the relationship of the extreme terms.

When the symbol is composed of several images grouped together, there is no reason why it should not keep its physiognomy as a whole, although one or more of its constituent elements may be modified, the better to answer to the religious traditions, the national preferences, and the geographical peculiarities of a new medium. Thus the lily, as M. de Gubernatis remarks in his Mythologie des Plantes, has taken the place of the lotus in the symbolic combinations borrowed by the West from the East. One of the most characteristic examples of these local variations with persistence of the type is presented to us by the figured representations of the sacred trees, in which we believe we can recognize the tree of life which is mentioned in both the Semitic and the Aryan traditions. From the most remote antiquity, the Chaldeans gave it the appearance of the date-palm, sometimes attended by a vine or an asclepiad similar to the plant that yields the *soma* of the Hindoos. The Assyrians made of it a wholly conventional tree, in which palm-leaves were associated with a cone-fruit, and the horns of the wild goat formed a kind of capital to the trunk. The Phœnicians exaggerated the artificial character of the representation by grafting the flowers of the lotus upon it. The Greeks introduced it into their ornamentation under the abbreviated

form of the palm-leaf or acanthus. The Persians adopted it with the conventional physiognomy which the Assyrians had impressed upon it, and it was thus carried to India, where the Buddhists substituted for it the sacred fig-tree of Buddha. On the other side, the Persians bequeathed it to the Arabs, who, stripping it of its religious signification, retained it as an ornament in the decoration of their jewels and cloths. Finally, reaching Europe in the middle ages, with cloths of Oriental origin, it was reproduced among the sculptures of some churches, where it represented sometimes the tree of the cross, sometimes, by a curious coincidence, the tree of life of the biblical traditions. In all these variations of the same theme, the plant constitutes only a part of the symbol. That is completed and characterized by the presence of two personages confronting one another—genii, demons, wild or fanciful animals, monsters half beast and half man, between which the sacred tree raises its stem or spreads its branches. Nothing more is needed to establish the affiliations of this complex image which brings into connection, through many thousand years, the Chaldean cylinders and the medallions of the Javanese pagodas, the Greek capitals of the Didymeon and the Christian tympans of Calvados and Gloucestershire.

A frequent cause of alteration, to which sufficient attention has not yet been given in the study of symbols, is the attraction which some figures exercise upon others. We can almost announce under the form of a law that when two symbols express the same idea or near ideas they manifest a tendency to combine so as to engender an intermediate type. For want of understanding that a symbol can thus be connected with several figures very different in origin and aspect, many archæologists have lost their time in disputing upon the origin of an image or of a sign which each of the parties had reason to connect with a distinct antecedent—like the knights in the legend who broke lances over the color of a shield of which one saw one side of one color and the other the reverse of another color.

Examples of such real symbolic transmutations are too numerous to be recited here. A simple and salient form of them is given in the wheel, which, possessing the double advantage of having a circular form and of implicating the idea of motion, is one of the most frequent symbols of the sun. When that star was likewise symbolized by an open flower, the effort was often made to fuse the two images. Thus, in the bas-reliefs of Buddhist India we find wheels the spokes of which are replaced by lotus-petals; while in the island of Cyprus there are coins bearing roses the leaves of which are encircled by twisted rays, or arranged in the form of a wheel. The special amulet of the Gauls, the solar *rouelle*, easily furnished, on the advent of Christianity, the

chrisme or monogram of Christ (X and P interlaced) by the simple addition of a loop.* In a similar way the *chrisme* becomes the ansated cross or key of life, through a series of transformations which are found among the inscriptions of the island of Philæ.

It is not even necessary that the symbols thus combined shall originally have possessed the slightest analogy of forms. There are certainly not many traits common to the different images of the sun in the valley of the Nile, where it is represented, according to the districts, as a radiating disk, a hawk, a goat, etc. But the Egyptians not only succeeded in condensing all these figures into the winged globe of their pylons and their cornices, but they also contrived to give the strange amalgamation the features of another solar animal, the flying scarabæus. When the winged globe passed from Egypt into Asia, the Assyrians in turn inclosed in the Egyptian disk the figure of their god Assur, which they represented as a winged genius, and till then the ancient sacred bird of Chaldea, which, according to M. Menant, contributed with the Mesopotamians to form the definite type of their winged disk, was not. Some of the coins of Asia Minor help us to comprehend the different processes by the aid of which the two symbols could thus be combined, if not also the principal stages of the operation by which they produced a third. The sun was often symbolized in Asia Minor by a *triscele*—that is, a disk around which radiated three legs joined at the thigh; at other times it was represented there, as in Egypt, by animals like the lion, the boar, the eagle, the dragon, and the cock. A coin of Aspendus in Pamphylia shows the cock in the field, by the side of the *triscele;* other pieces of the same origin show the *triscele* placed over or joined to the body of the animal without its losing its natural appearance. Finally, in a Lycian coinage, in the British Museum, the two symbols, at first placed together, then joined, are literally fused into one another; the three legs of the *triscele* are metamorphosed into three cocks' heads, which are grouped in the same way around a center.

Most frequently the symbolical syncretism is conscious and premeditated, whether the matter be one of the union for greater efficacy of the attributes of several divinities into a single talisman, or one of affirming, by the fusion of symbols, the unity of the gods and the identity of cults. Of such character were the talismans called *panthei*, with which the Gnostics endeavored to condense the divine symbols supplied by the principal religions

* M. Gaidoz, in his book on the Gallic God of the Sun and the Symbolism of the Wheel (*Le Dieu Gaulois du Soleil et la Symbolisme de la Roue*), defines the *chrisme* as "a wheel with six rays without the circumference, and with a loop on the top of the staff in the middle." It should be added that even in the catacombs the *chrisme* is sometimes drawn within a circle.

of their time. Of a higher order of ideas was the symbol adopted by the Brahmanists of the New Dispensation—the Brahmo-Somaj—who presumed to fuse all the existing sects of India into a new religion, founded exclusively on conscience and reason. The pediments of their temples bear a design in which the mystic syllable of the Brahmans, *Aum*, is interlaced with the Mussulman crescent, the Sivaite trident, and the Christian cross. It also frequently happens that this confusion of symbols is not at all systematic. By virtue of reproducing certain forms, the eye and the hand seem to be assimilated to them to such a degree that they are not able to rid themselves of the obsession when they attack new themes. There is a symbol of this kind, engraved on Phœnician gems or painted on Cypriote vases, which recalls the winged disk of Asia, the sacred tree of the Assyrians, and some of the Greek thunderbolts. One can not turn the leaves of the description of the Buddhist bas-reliefs of Boro Boudour, in the island of Java, published under the direction of the Dutch Government, without being struck, at almost every page of the Atlas, by the appearance of some curious figure which presents at once reminiscences of the Hindoo lotus, the Assyrian horns, the Greek thunderbolt, the Buddhist fig-tree, and the Egyptian globe with the Uræus. Such heteroclite mixtures have, moreover, been customary in Oriental symbolism. Sir George Birdwood, an author among the best versed in the industrial arts of modern India, has recently shown that in the Hindoo art, in which all the details have a symbolical bearing, certain decorative themes are combined and exchanged with the disorder of a dream, without regard to the distinction of the animal and vegetable kingdoms, or of the organic and inorganic worlds.

In most of the examples that I have cited it is easy to discover by what ways the symbol was transmitted from one people to another. Under this relation the migration of symbols rises directly from what may be named the history of commercial relations. Whatever may be the resemblance of form and signification between two symbolical figures, found among peoples of distinct origin, it is proper, before asserting relationship, to determine the probability, or at least the possibility, of international relations that may have served as a vehicle for them. This point fixed, it remains to be determined which has been the borrower and which the lender. Thus, why was it not the Hindoos who communicated the thunderbolt to Mesopotamia, the Phœnicians who received the caduceus from Greece? Here our advantages over preceding generations appear. There was a time when we might indistinctly place in India the origin of the gods, myths, and symbols that are scattered all over the world; another when it would have had a bad air not to give Greece credit for

all intellectual and religious creations that had any moral or artistic value. But the investigations of the last half-century have given positive bases for the ancient history of the East; and that in turn permits us to restore to their true plane in the perspective of the ages the principal centers of artistic culture which have reacted upon one another since the beginning of civilization.

There may be differences of opinion as to whether the Ionic capital borrowed its volutes from the horns of the ibex or the half-opened petals of the lotus. There may be discussion as to whether Ionia received it directly from Golgos on the Phœnician vessels, or from Pteria with the caravans of Asia Minor. But no one who has observed its presence on the monuments of Khorsabad and Koyoundjik will refuse to locate in Mesopotamia the point of its departure toward the Ægean Sea. This is only an example of the types and motives the development to importance of which is doubtless due to the autonomous inspirations of Greek genius, but the origins of which are to be sought in Phrygia, Lycia, Phœnicia, and beyond, in the valleys of the Tigris and the Nile. In India, likewise, the most ancient works of sculpture and carving—wherever they do not attest a direct influence of Greek art—associate themselves with the monuments of Persia by the adoption of motives in some way classic in the Persepolitan architecture—like the capitals formed of animals sometimes affronted, sometimes backed; which are, as a plastic signature, in the former case of Assyria, in the second case of Egypt. In fact, when we depart from Greece or India, or even Libya, Etruria, or Gaul, we always come at the end, stage by stage, upon two grand centers of artistic diffusion, partially irreducible to one another—Egypt and Chaldea; but with this difference between them: that about the eighth century before our era, Mesopotamia went to school to the Egyptians, while Egypt never went to school to any one. Now, symbols have not only, as we have shown more than once in the course of this study, followed the same routes as purely decorative themes, but they have also been transmitted in the same fashion, at the same times, and, we might say, in the same proportion. I am far from disputing that there may have been independent and autonomous centers of creation among nearly all peoples. But, besides autochthonous types, we find everywhere the deposits of a strong current whose more or less remote origins lay in the symbolism of the shores of the Euphrates and the Nile. In short, the two orders of importations are so connected that in writing the history of art we write in great part the history of symbols, or at least of their migrations—as is exemplified in the studies of MM. Perrot and Chipiez in the history of ancient art.

A distinction, however, should be observed, in researches rela-

tive to symbols, that form is not all. It is the intention that makes the symbol, and by this symbolism is dependent upon psychology, at the same time that its history deserves a place by itself in the general picture of the development of human civilization. A word is to be said from this point of view concerning other migrations; those in which a symbol passes, no longer from one country to another, but, upon the same soil, from one religion to the one that succeeds it. In the most frequent case, it is popular pressure that introduces into the new civilization symbols consecrated by long veneration. Sometimes the innovators themselves use the advantages offered by symbolism to disguise the novelty of their doctrine under ancient forms, and, when necessary, to transform into allies emblems or traditions which they are not able to destroy by a direct attack. Thus Constantine chose as his standard the *Labarum*, which could be claimed at once by the worship of Christ and by that of the sun. The same policy was attributed to the first king of Norway. According to an old song of the Shetland Islands, Hakon Adalsteinfostri, compelled to drink to Odin at an official banquet, drew the sign of the cross on his cup, and, when his guests reproached him for it, told them that it was the sign of the hammer of Thor. We know, in fact, that in German and Scandinavian countries the cross of Christ was more than once disguised under the form of a two-headed hammer, and that in more than one inscription in Egypt it put on the appearance of the key of life.

Such symbolical adaptations have been especially frequent in Buddhism, which has never been restrained from adopting the symbols and even the rites of anterior or neighboring religions. In some of its sanctuaries it has gone so far as to carve the ceremonies of the worship which natives of India gave to the sun, fire, and serpents, and connect such rites with its own traditions. The solar wheel thus became the wheel of the law; the sacred tree represented the tree of knowledge under which Sakya-Muni attained perfect illumination; the serpent *Naza* was transformed into a guardian of the footprints of Vishnu, which were afterward attributed to Buddha. Some years ago the remains of a Buddhist sanctuary were discovered at Bharut, in which the bas-reliefs represented emblems and religious scenes, accompanied by inscribed legends. The news gave great joy to the Anglo-Indian archæologists. They expected to be given interpretations of Buddhist rites and symbols, formulated by the Buddhists themselves one or two centuries before the Christian era. But a closer examination showed that the shrine was only an ancient temple of the sun, which had been taken possession of by the Buddhists. They were satisfied to put over the pictures of solar worship inscriptions connecting them with their own faith.

It has been said that religions change, but worship continues the same. The assertion in this shape is too absolute; but it is certain that every religion preserves in its rites and symbols survivals from the whole series of previous religions. And this does it no harm. The important thing is, not the leather bottle, but the wine that is poured out of it; not the form, but the thought that animates it and goes beyond it. When Christians and Buddhists respectively concentrate upon their Master the principal attributes of the sun, beginning with the nimbus, the prototype of which goes back to the aureoles engraved upon the Chaldean monuments, they do not suppose themselves to be giving homage to the star of day. They only intend, in reality, to reflect upon the venerated face of their founder the symbol which has from time immemorial formed an image of the celestial glory, and which also, in contemporary cults, specially characterized the highest personification of divinity. We are reminded of the answer which a father in the Church gave to those who accused the Christians of celebrating the day of the sun: "We solemnize this day, not, like the infidels, on account of the sun, but on account of him who made the sun." Constantine went further when he composed a prayer for his legions to recite on Sunday that could satisfy at once, as M. V. Duruy remarks, the worshipers of Mithra, Serapis, the sun, and Christ. Symbolism may ally itself with the most mystic tendencies, but, like mysticism, it is a powerful auxiliary of the religious sentiment against the immobility of dogma and the tyranny of the letter. M. Anatole Leroy-Beaulieu has shown, pertinently to this point, how in Russia the conservative ritualism of the old believers has been able, by means of the symbolical interpretation of texts and ceremonies, to attain liberty of doctrines and, in certain cases, a complete rationalism, without breaking with the traditional forms of Christianity or of the Eastern Church.

There comes a time when religions which make an important factor of the supernatural find themselves in conflict with the progress of knowledge, and especially with a growing belief in a rational order of the universe. Symbolism then offers them a way of safety which they have more than once taken advantage of to keep pace with their times. If we take peoples in an inferior degree of religious development, we find them having fetiches—that is, beings and objects arbitrarily invested with superhuman faculties; then idols, or fetiches carved into resemblance of a man or an animal; but we rarely discover symbols among them, for they imply both the desire to represent the abstract by the concrete and the consciousness that there is no identity between the symbol and the reality for which it stands. When the mind opens to the notion of abstract or invisible gods, it can preserve its veneration

for its ancient fetiches, which are thenceforth regarded as representative signs of the divinities. Finally, when we come to conceive a Supreme God, of whom the old divinities are simply ministers or hypostases, the ancient figurative representations may still have a place, provided they are put in relation with the qualities or attributes of the superior being into which the divine world resolves itself. This is an evolution of which traces are observed almost everywhere in ancient polytheism. Dogmas and sacraments can always, on their side, be brought by symbolism into an interpretation harmonious with the progress of knowledge and reason. Such is the task to which are devoted—after Schelling and Hegel in Germany, and Coleridge and Maurice in England—a notable fraction of Protestant theologians, with a success which would doubtless have been greater if the school had not broken with the laws of historical truth by persisting in projecting into the past interpretations inspired by the present.

A religious condition may be conceived in which all cults become purely symbolical. There will be nothing to hinder their preserving with a pious care the rites and traditions of their heritage; only they will make of them particularly symbols of the truths common to all religions, and will consequently be able to treat one another—as we see in the rites of certain churches—as local forms and equally legitimate in the universal religion.

Such a syncretism looks, at first sight, to be very far from us. It would imply that all religions have their share of the truth, but that none possesses it all. This is hardly the language of the larger contemporary churches, if we may judge by those that touch us most nearly. But it must be observed that, in practice, their adepts live among one another as if the divergence in doctrines were reduced to a diversity of symbols. At times we see their chiefs—a thing unheard of in former centuries—co-operating on a footing of equality in works of philanthropy or social peace, as if they recognized that charity and justice afford a common ground for religious activity. Lastly, the attribution of a relative value—or symbolic, which is the same thing—to all cults indistinguishably may serve hereafter as a basis for the normal relations of the state with the churches in the countries which are under the influence of modern law. Let this idea, already anchored in our laws and our customs, be accepted in our consciousness, and for the first time in history the world will be able to enjoy a religious peace, founded not on the unity of forms and formulas, but upon the admission of what, under variety of symbols, is true and fruitful in all religions.—*Translated for The Popular Science Monthly from the Revue des Deux Mondes.*

MOTHERS AND NATURAL SCIENCE.

By MARY ALLING ABER.

A ROBIN teaches its own young to fly; a human mother often leaves the training of her babies exclusively to others. The bond of nature between the mother and child puts a premium on all that the mother does, and her constant association is an opportunity for understanding the peculiarities and needs of the child such as no ordinary teacher ever obtains.

As one's finger may trace in the yielding soil a channel for the outflow of a tiny spring, and at its fountain-head determine the course of a river, so, in the earliest years, the mother may, with little effort, give direction to the energies of the child. The mother's capacities, education, and circumstances may not permit her to accompany the child far on its course, or to contribute much to the current of its intellectual life; but let her give the direction and all the powers of nature will conspire with the child's inborn force to increase the volume and strength of the on-rushing stream.

To claim for natural-science studies the mother's power of direction, to show why mothers should interest their children in these studies, and to suggest how they may do so, is the purpose of this paper.

What mothers may do to interest children in natural science is a question which has but one answer—they may do everything; what mothers can do has as many answers as there are mothers. Between the may and the can is but one barrier—difficult to destroy—the mother's own habits of thought. Not ignorance, not scarcity of materials, not want of books—not all of these combined need long block the way of any mother whose mind still has the suppleness and sincerity of childhood; for the door into this kingdom of nature, like that into the kingdom of righteousness, is the simplicity of childhood.

It would be well, in these days of the supremacy of the material life and of increasing demands for applied science, if young women who are pursuing courses at our colleges would more often elect science studies, that they may be ready, by power to teach and by assistance and appreciation given to others, to further the introduction and pursuit of science studies in all lower schools; and to do this in a manner which shall help to put science in its true place as the handmaid, and not the destroyer, of religion.

But it is to those who have passed their school and college days that this paper must be addressed. As no body gets so stiff that proper treatment can not restore some of its lost pliancy, so

no mind is so helplessly set that it can not be drawn forth and directed into other molds. What a mother can do to interest her children in natural science depends upon her power to direct herself and to master the conditions of her life. Suppose that power is sufficient, how shall she begin? A mother may think that she needs trained guides, lest she make mistakes and waste precious time and strength. She may wish to know what materials to collect, what books to buy, when and where to get the materials and books, how much time and money they will cost, and what she is to do with them when obtained. Every mother has a right to ask these questions of any one who urges her to undertake to awaken in her children a vital interest in Nature's phenomena; but all that the writer of this paper can hope to do is to give suggestions which may lead a mother to find elsewhere the definite answers required.

A mother may begin to study with her children the ever-changing phenomena that surround daily life. The house is full of lessons. Various departments of science have contributed to its building and furnishing. There is scarcely an industry that is not represented in some room; the kitchen is a laboratory in which the truths of chemistry and physics are illustrated, and the table is supplied with gifts from the three kingdoms of nature; and to produce these, to transport them, and to prepare them for use, numberless natural agents have worked tirelessly and long. And out of doors—Nature's phenomena—where are they not? The snow and rain bring them; the ice locks them across the pond and the south wind picks the lock, the breezes blow them, the birds sing them, the brooks murmur them; every tree and flower, every stone and clod wait to tell their story; the waves wash their treasures to the shore; the rainbow is their expression; the glories of morning and evening write them on the sky; the sunlight comes and goes, bringing the wonders of night and day, of storms and seasons; and all night the stars speak of times and spaces our mathematics can not yet compute, and of events before which our short earth-lives shrink into nothingness.

What shall a mother take from this vast store to give to her children? Before answering this question it is proper to consider what purpose natural-science studies may serve in the education of a child; and to do this, the objects of education itself must be known. The supreme object of education is, without doubt, the development of the individual to the utmost limits his consciousness can grasp in this earth-life; some of the lesser objects are a vocation and success in it, pleasant social relations, ability to help the unfortunate, interest in national affairs, and a love of the virtues; and all these may be included under the expression

to be a good citizen. These objects imply health and industry, that the man or woman may be a producer and not a consumer only; sufficient intelligence to recognize and perform duties to one's self, to one's neighbors, and to the State; speech which is honorable and pure; and deeds which inculcate respect for the laws. Besides these, a mother may wish her child to acquire those graces of mind and heart that are difficult to define in words, but whose presence or absence is easy to feel in a man or woman; those graces which lift their possessor above the power of petty passions, of foolish conventionalities, above even the necessity to forgive injuries.

Emerson, in speaking of Lincoln, said: "His heart was as great as the world, but in it there was no room for the memory of a wrong." From the days of early manhood to the crowning act of his life, what a succession of kindly deeds are found in Lincoln's history! As the mind dwells on them, the great Proclamation is seen to be but the consummate flower on a plant which could bear no other. Such men do not fail when the time for great action comes. They do without fear what lesser men shrink from, or dally with, until the time for action has passed. No small soul, no life full of petty motives, ever rises to a great emergency. To one who meets the details of every-day life with a vain, selfish spirit the great occasion may come; but his will not be the honor of seeing it and of using it worthily. So, if a mother would have her children become men and women of the larger type, she must look well to "the reiterated choice of good or evil which gradually determines character."

What can natural sciences do toward this character-building? Have not studies other uses? Yes; but, while serving other uses, a study which does not mold character is of small value. This character-building receives little or no consideration in much that passes for education—a mistake from which the whole after-life of the child suffers. There is at present a "craze for information," as though to be a store-house of facts were a thing desirable in itself. Information so assimilated as to be a source of ready power in thought and conduct is a great good, but unless so available it is of little value. The mere desire for getting information might well be called intellectual avarice, for he who seeks this alone is almost as useless and miserable as the more sordid hoarder of money. Also, there is an idea, somewhat current in these days, that for children study should be transformed into play. I must protest against any such notion. Hard, patient, honest work is needed. The child who plays at his studies will play at life, play at everything, and will probably carry from cradle to grave the deception that whatever does not furnish him amusement is of no value, that work belongs of right

only to those miserable beings who have little capacity for amusement. There should be much delight in study, but there will be disagreeable drudgery as well, and any training is false which does not teach the child to do the drudgery promptly and faithfully. A mother who saves her child from disagreeable tasks does him the grave injury of sending him forth into adult life without the fixed habits which will enable him to meet its responsibilities with ease and dignity.

Now, for all this development of a child into a worthy man or woman natural-science studies have peculiar fitness. To secure and preserve health, considerable knowledge of these studies is a necessity; and their relations to preparation for self-support are obvious. In the proper pursuit of natural-science studies the capacities for accurate observation, for painstaking experiment, and for unbiased sincerity are developed; and without these capacities there can be no true progress in them. A slight prejudice introduced as a factor in estimating the results of a series of observations will vitiate the result, and may ruin the value of the whole work. Natural-science studies are as exact as mathematics in demanding obedience to their own laws. Reflection upon these considerations will show their value for intellectual development and training. The moral and spiritual influence of these studies is not less great. A child learns to be truthful in the presence of truth that never swerves; learns to be gentle when at work where one rude touch may destroy the labor of weeks; to be brave when he sees the struggle which everything in Nature makes for its own development; to be patient in waiting for Nature's slow processes; persevering when he sees that she gives up her secrets after repeated efforts only, often to be made under circumstances appalling to a spirit less mighty than her own; modest when he and his little come into daily comparison with her and her abundance; obedient when he sees that obedience to law brings beauty, pleasure, and life, and disobedience brings deformity, sorrow, and death; reverent before the majesty and power and glory of Him who is the life of Nature; generous, because she pours out her whole wealth to-day, never fearing that the morrow will not care for itself; joyous, because above all her struggle and pain rises a perpetual pæan of triumph.

If convinced that natural-science studies have special fitness for the training of children, with what study shall a mother begin to work? Although Nature herself indicates an order which may be pursued with advantage, this order is not so important that it need be attempted where conditions do not favor it. This order takes, first, rocks and soils, with enough of chemistry and physics to explain some processes of soil and rock making; second, plants, as depending on soil, air, and sunlight; third, animal life; and

fourth, man's structure. After this order has been observed through an elementary course—just enough to give a hint of the cycle of change from the rock world through the soil, plant, and animal, back to soil and rock again, to show the intimate dependence of Nature's kingdoms and processes—these studies may be carried on together, a few weeks of each year being devoted to each one. This may be done until the student has reached the years when he may wisely devote himself to one branch as a specialty. Attention to the whole cycle of Nature is not inconsistent with thoroughness, since the little that is selected from each part may be thoroughly studied. A little work well done is of more value than to run over the whole field superficially, not only to the contents of the child's mind, but to his growth in character.

It matters little where one begins, so that the study be honest and thorough. Any beginning will lead everywhere else, for, though there are straight roads for the specialists to follow, the whole field is covered by a most intricate network of roads. A mother may begin where her present knowledge is least liable to blunder. If she had a fondness for physics in her school days, let her take that. Let her teach her child the laws of mechanics as illustrated in his daily life and observations. Let her teach him to drive a nail properly, and she teaches him to avoid the working of the law of the wedge; teach him how the windows are hung, and she introduces him to weights and pulleys; show him a man unloading a barrel of flour at the door, and she shows him the inclined plane; in teaching him to use a pair of scales, a can-opener, a claw-hammer, a nut-cracker, she teaches him the use of levers. The wheel and axle may be taught from the well or the clock.

The properties of bodies and the laws of expansion and contraction find abundant illustration in the daily life. Let the child fill an old jug with water, cork it tightly, and set it out of doors some cold night. The break found the next morning will not be forgotten. Then take him to a neighboring ledge of rock, show him its cracks filled with ice, and he will not be slow to draw the lesson of how the strong rocks are broken asunder. Then show the child the tiny snow-flake with its six crystal arms, so delicate that you hold your breath lest they vanish while you look; and lead him to see that the jug and the mighty ledge of rocks are broken by these fairy creatures. What tale in mythology or folk-lore is more wonderful than this? In every drop of water is the fairy crystal spirit, but it can not embody itself where heat is. Cold is its good genius; and when cold comes, the fairy spirit works, throwing out one dainty spar after another and interlacing them with threads more delicate than those in our finest

laces; and the fairy spirit has a body; the crystal exists. But if the water is confined and has not room enough, why, these frail things break the bond, break the jug, break the giant rocks. If this story is well taught, the child's soul will bow before it in reverence. He will learn, too, one old but great lesson which may be applied in human affairs—"In union there is strength." The single ice crystal seems powerless; the many do mighty work.

If a mother is fond of chemistry, she has no less a field of work from the combustion of fuel and the burning of the evening lamp to the whole process of cooking, digesting, and assimilating food. Here, too, comes the question of the purity of air, water, and foods. A child may be taught to detect some impurities in all these, and also to test the safety of the colors in wall papers and in the fabrics used for clothing and furniture. These are but a few of the many topics close at hand for every mother fond of chemistry. Through all of this work in chemistry the mother has admirable opportunity to impress on the mind of the child the great economy of Nature. As the child sees the wax of the evening candle gradually disappear, he may be made to understand, by a few simple experiments, that some portion of the air is uniting with the wax; that invisible watery vapor and gas are produced and pass into the air; and that soot is given off. She is then prepared to believe Nature's great law—change, but no loss. The child, once impressed by this law, will find abundant illustrations of it, and will seek to know and understand the changes which produce the seeming losses so constantly occurring.

Perhaps some mother has a preference for astronomy. In warm evenings the little ones may sit out awhile to listen to stories about the stars. No subject is more delightful to a child. The little of the great truths which he can grasp will awaken and broaden his young mind and fill his tiny heart with noble and poetic sentiments.

Botany, zoölogy, and physiology will suggest fields of work as boundless as they are interesting. It is not necessary to suggest special lines of work in each; but let me urge that the intimate relations of everything studied to the life of man should be kept before the child, so as to cultivate that sympathetic interest which tends to produce gentleness and humanity toward all things. The song-bird rids his garden of insects, and the pretty wayside flower furnishes him medicine. By invisible but real bonds the life of man is united to the lowest animal and the smallest plant.

While it does not greatly matter where a mother begins, it does matter that, as she goes on, the child see relations clearly. Hence arrange the work in logical sequence, and branch off soon into other fields, that the little mind may have a natural, broad base on which to arrange its treasures of knowledge. All this,

too, must be varied according to the age and tastes of the child. Rightly presented, any one of the subjects named will soon win the respect, love, and enthusiasm of any child not hopelessly spoiled by too early dissipation in artificial social life. Such studies are one of the best correctives of this evil, and I have seen them cure some painful cases of it.

To a school where I was teaching there once came a child of nine, with manner and face plainly stamped with artificial life, and for weeks her teachers despaired of ever seeing any genuine, simple feeling. The child did not for a moment lose a painful self-consciousness which did not forget to air her charms at the entrance of a visitor, or when she wore a new article of apparel, as she frequently did. The first time she was asked to make a bill of materials which she might buy—materials of any kind—simply to show how bills are written, her bill began:

To one pink satin ball dress..... $80,
" one pair white kid boots..... $15,

and proceeded through eight or ten similar items of fancy and expensive dress. After our first vacation of one week this child returned with a glad, eager look on her face, and, going close to her teacher, said: "I am so glad school has begun again. There is nothing interesting going on at home." From that day her manner gradually changed; she came to love the stones, flowers, and animals which we studied, and her face lost its blank, soulless look and became sweet and gentle. This change in expression was so marked as to be spoken of by a frequent visitor.

Materials for study in any department of natural science are so abundant that it seems almost unnecessary to touch upon this topic. The greater abundance of botanical and zoölogical material in summer invites to those studies at that season, while physical and chemical studies may quite as well receive attention in winter; but with care and a small outlay in money any of these studies may be pursued at any season. A window garden, where a child may plant seeds at varying intervals and then pull them up and examine the whole plant at different stages of growth, is possible at any season; but this had better be done in early spring, when the vegetation starting out of doors increases the interest of the child and supplements his work.

The preservation of materials and the formation of collections are important. Encourage the child's efforts in this direction. Let the boys and girls make shelves, boxes, or cabinets in which to keep the collections. A set of wood-working tools and ability to use them will be a useful adjunct to natural-science study.

Whatever a child collects should be received with a smile of encouragement, no matter how worthless it is, until he has gained some power of discrimination. Let a mother refrain from show-

ing disgust or fear of any natural object—even of toads, spiders, and snakes—lest she foster in the child the common superstitions which attach harm to innocent creatures. And if the child brings a handful of frogs' eggs, sticky and dripping, the mother had better not say, "Now go away and throw those horrid, dirty things out; I will not have the house filled up with them"; and proceed to chide him for soiling his clothes and dripping water on the carpet. Let her show the child she is pleased with what he has done; get a jar in which to put the eggs, call the child's attention to the tiny dark spot in each egg, awaken his interest by telling him how the eggs were deposited and why they are fastened together in such a gelatinous mass, and that if he keeps them and gives them fresh water, a little animal may come out of each one. This will keep alive the spirit of investigation; and, after all this has been done, she may show the child how he might have kept from soiling his clothes and the carpet. A mother should never make fun of a child or laugh at his preferences, but try to enter into the child's thought and feeling, and, having done this, she may lead him to what she wishes. She should be patient, too; for, while the child's perceptions are often more keen and true than hers, he will find it hard to follow her reasoning processes and to see relations which are very simple to her. A mother should teach kindness by her own treatment of helpless creatures. Let her not crush the insect in the house, nor pull the weed from the garden with anger or impatience, but teach her child respect and kindness for all life until he has reached years when he can clearly distinguish between necessity and cruelty.

Be glad when questions are asked; hail them, if they grow naturally from the lessons, as the dawn of a good day for the child. Never say—as many a mother and, alas! many a teacher does in answer to a child's question—"Oh, that is too hard for you; you must wait until you are older." Is it surprising that children so treated lose courage and go through life thinking of every new difficulty, "Oh, that is too hard for me." There is a simple side to every subject; and if a child comprehend not a tenth of what is said, he is helped and satisfied by the effort to treat him as an intelligent being. If the child can not answer the mother's questions or his own, he should, if possible, be sent to Nature herself to find the answer, the mother giving only so much help as to direct his attention and insure his finding the answer within a reasonable time.

The child himself should handle the objects, manipulate the materials in experiments, make and record observations, and so learn to give accurate attention, and to keep exact accounts of what is seen, to use his own hands and eyes, to do. He who can do as well as think is twice armed against poverty or misfortune.

Accidents may be turned to account, not only to teach how to avoid them, but the immutability of Nature's laws. The sooner a child finds that Nature never forgives a sin against her, the better for his health and happiness. I know one mother who has taught her child to see the relation between headaches and candy; and so well he understands it that now, at ten years of age, he does not overindulge, although the favorite sweets stand always on the library-table within his reach.

Take advantage of any unusual phenomena. The last transit of Venus was a chance offered not again in the lives of ourselves or our children, and every one might have seen it through a piece of smoked glass. A recent railroad-cut exposed fine examples of ripple marks, which will soon be buried from sight by falling earth. After some storms there are exceptional opportunities for lessons in physical geography and geology. Such chances are of more value than many things for which we put them aside.

The relation of natural-science studies to health and to the mental and moral culture of children has been suggested. Their industrial uses are familiar to all; so intimately are they connected with the life of man that knowledge of any branch makes one more capable in the conduct of his life. The relations between these studies and the great workshops of the world may with advantage be pointed out until the child feels the mighty pulse of the world's work and acknowledges his debt of service and brotherhood to all men. The habits of mind produced by continual contact with things, forces, phenomena, and laws promote clearness of insight and ability to look over a wide field, and to gather the facts necessary to form right conclusions. These are the habits which give success in business.

Another important advantage in the study of the natural sciences is found in their relation to invention. The emancipation of man from continuous manual toil is the prophecy which Science has already uttered; and she but waits the men to put her forces at work in the right ways to fulfill this prophecy. A child rightly started has before him the possibility of doing some of this needed work, and so adding to the sum of human knowledge and comfort. If he does not do this, he will have the understanding which will appreciate and encourage the labor of others; and if his pursuits early lead him quite away from the impetus to those studies which his mother may have given in childhood, still her labors will be rewarded by the increased enjoyment which touch with Nature adds to any life.

For mothers who have acquired little or no knowledge of natural science, it may be well to indicate some of the best sources of information and direction. For the most elementary works,

Appletons' Science Primers and Ginn & Co.'s Guides to Science Teaching are among the best. For more advanced standard books, the works of Dana, Le Conte, and Geikie in geology, of Dana and Brush in mineralogy, of Gray and Bessey in botany, of Packard and Huxley in zoölogy, of Huxley and Martin in physiology, of Remsen in chemistry, of Meyer and Wright and of Ganot in physics, of Newcomb and Young in astronomy, are among the best.

Better than books are the collections of a well-arranged museum if they are by good fortune accessible. If possible, use them with the children, not for the amusement of an idle hour, but as teachers speaking more directly from Nature's heart than books can do. Also better than books is contact with a living teacher and association with others interested in the same work. Such help may be sought with assurance that one will seldom fail of kindly welcome and of all possible assistance. The Agassiz Associations, whose president is Mr. Harlan H. Ballard, whose headquarters are at Pittsfield, Mass., will furnish any mother with the opportunity of putting herself in contact with workers in this field, and of getting invaluable aid and inspiration.

Thus far in this paper the benefit of the study of natural science to the child only has been considered. But what of the mother? Truly, what increases the well-being of the child must increase hers also; but is there no personal gain to her apart from her child? Will it be nothing to be introduced to Nature, and to become a welcome guest where one has been a comparative stranger? Will it be nothing to leave the artificial and conventional, where so many masks are worn, and make friends with Nature, who cares nothing about dress, income, or pedigree?

Few mothers have not felt the renewal of youth which comes when in the woods, on the mountain, by the shore; have not found their cares slipping insensibly from them when gazing into the depths of the sky, listening to the murmur of a brook, or inhaling the sweet breath of the summer wind. Let me assure these mothers that every step in the study of any natural science will open more wide the door through which Nature will pour such healing balm.

O mother, tired with housekeeping, give your family simple, uncooked fruit for dessert; let puddings and pies go unmade, and give the time so saved to the pursuit of enduring pleasures; finish the little dress with a few less ruffles, and fashion for your child's mind a garment which can not fade or grow old; make fewer calls on your fashionable friends and more to the wood-lot, the open meadow, and the running brook; lay aside the latest novel, and go

> "Read what is still unread
> In the manuscripts of God";

do not stop to gossip about the newest scandal, your neighbor's new bonnet, or forthcoming party, but pause and bend your ear in the quiet places where the secrets of all life are told.

You have many hindrances in fashion and conventionalities. Do you wish you could stop and live differently—live more simply; wish you could offer family and guest alike simple bread, vegetables, and fruit without the fuss of the many courses and interminable combinations which consume time and often ruin the digestions and tempers of those who partake of them; wish you could get a few simple, artistic patterns for your own and your children's garments, and use them year after year without all this harassing discussion of what is style and fashion; wish you need go to no large parties, or ever give any, but let the few chosen friends come when they desire and take you and your home life as they find them? Do you wish all these? Then prove the desire by making them all true. But you answer, "I can not unless everybody else does." 'Tis the old story of "foxes and tails." We actually follow the maxim, "your conscience, not mine"; and forever is asked not, Is it right? but What will they think?

Why not make these radical changes? Every step of progress was once a difference which some brave spirit bore alone. Instead of fearing to be different, one may be proud and thankful to have found a better way to live: "The great world will come round to you."

COTTON-SPINNING SOUTH AND NORTH.

By HENRY V. MEIGS.

IN The Popular Science Monthly for January, 1890, appeared an article from the pen of Mr. Edward Atkinson, under the title The Future *Situs* of the Cotton Manufacture of the United States. In this essay Mr. Atkinson writes of what he understands to a remarkable degree, but I am confident that in some particulars there is a more favorable outlook for cotton manufacturing in the South than he is aware of.

First, as to the matter of sufficient humidity in the air, which, as he truly says, is so essential to success, especially in the manufacture of the finer numbers of yarn. An old gray-headed carder once told me that in his early experience in Scotland he was very much annoyed by the refusal of the drawing-frame slivers to fall into the eight, ten, and twelve inch cans supplied for their reception. This was before the invention of the pressing rollers, which force the slivers down where they should go. In his vexation one day, having a belt-awl in his hand, he raised his arm and plunged

the awl into the bottom of a thin steam-pipe which passed overhead. A jet of steam rushed out right down upon the refractory sliver, and, to his astonishment, down it went right into the can.

I have myself seen these same disobedient slivers fly all around a man's neck and shoulders and adhere there, to the great disgruntlement of foreman and hands. At the same old mill, above Columbus, the second if not the first mill built in the State of Georgia, the machinery was second-hand, brought from some Northern State. The spindles (fliers) were very ancient. Sometimes when they had a fair chance in fine weather they did pretty well, and at other times they would vex a saint. The very moment the sun sank behind the crest of the Alabama hills, however, there commenced an improvement in the action of these old spindles. Soon the room was in order; the boys and girls who attended the frames had a little time to "clean up," and their task was a light one for the rest of the evening. It seemed to me that the change was due to the humidity of the air inside, when the dampness of the falls right at the side of the mill was saved from evaporation by the withdrawal of the hot and drying sun-rays.

Mr. Atkinson writes wisely and well upon the subject of comparative humidity in different sections, and only *alludes* to means of artificial correction. Does it not seem probable that, with an efficient hygrometric testing apparatus, and with steam always at command capable of being admitted to a part or the whole of a department, the condition of the inside air, in this respect, may be kept almost uniform? The expense would be small, and the foreman, after being instructed, might be left to control the humidity of his room, as he is left to control its temperature. It appears to me that this consideration tends to make all manufacturing processes independent of climatic peculiarities.

Mr. Atkinson's remarks as to the coarser work of the Southern mills are all correct and go right to the root of the matter, but the inevitable changes to finer work have already commenced here, compelled, as they are at the North and East, by Southern as well as Northern competition. I was told years ago that a Northern manufacturer said that he could afford to pay ten thousand dollars per annum to get rid of the competition of one Southern mill on the same line of goods as those he was making.

Mr. Atkinson seems to have reached correct results, in his estimate of the comparative cost of raw cotton in Northern and Southern mills, but he does not allude to all the points that deserve consideration in respect to the ultimate cost of cotton *in the goods*. A Northern spinner recently mentioned his estimated waste at sixteen and three tenths per cent, but subsequently wrote me that he thought it was then about fourteen per cent. I think that Northern spinners usually estimate it at sixteen per cent. Even

fourteen per cent seems a very large wastage from "middlings," the grade my correspondent uses; which I attribute to his using the Gulf and Southwest cottons—from Texas, Louisiana, Mississippi, etc., made mostly by negro labor—in preference to cottons from the upper counties of this State (Georgia), made largely by white people—the farmers, their wives and children, who certainly handle the fleecy staple with far more care. The cotton marketed at Marietta, in Cobb County, about twenty-five miles above Atlanta, is generally beautifully white and clean. It is grown much more abundantly than before 1860, and almost always by the aid of fertilizers, which hasten the maturity of the cotton, so that the crop of that part of the country is much sooner prepared for market than in the lower counties, where it was often plowed in to make way for the new crop. The prejudice in favor of the Gulf cotton has always seemed to me to be unfounded, though I know it to prevail in Old as well as in New England, and generally in the North. These Northern spinners have often bought uplands in New Orleans, shipped from Columbus and Macon in this State. An old planter, who had also been a large cotton-buyer and a manufacturer as well, always combated this idea. When the yarn has fourteen to twenty turns of twist to the inch of length, it will certainly fulfill all the necessary conditions as to twist, as well as if the fibers were half as long again as they are. American spinners use a much higher grade of cotton for low numbers than the English spinners, to which I attribute the statement made to me by a Georgian of very high intelligence, who spent a number of years in China, and said that the Chinese greatly preferred American to English cloth, and I believe he said yarn also.

There is also, in my judgment, a very considerable advantage which the Southern spinner enjoys over his outside competitors; in that he receives his cotton in the loosely packed planter's package, measuring in depth twenty-eight to thirty-six inches, while his competitors receive the same staple from the compresses, in which the bale is squeezed down to a thickness of eight or ten inches under hundreds of tons of pressure. It *must* be brought into a flocculent state again before it can be carded and spun. Does it not go without saying that the loosely packed cotton in the planter's bale will require less violent tearing to restore its lightness and elasticity than that which has been packed for months under the compress with its enormous power? I have seen myself, often, cotton "in the seed" brought to the mill, weighed in two and four-horse wagons, without any baling at all, ginned *in the mill*, and spun at once.

Now as to some other points. Suppose that I build two mills for myself (to insure the same management exactly). Let them be exact counterparts of each other, except that the machinery of

one is propelled by water at Augusta, and that of the other by steam north of the Potomac. Let both mills be required to produce the yarn from 4,000 bales of raw cotton, each weighing 480 pounds. The annual consumption will then be, in each mill, 1,920,000 pounds. With waste estimated at fourteen per cent, the quantity sent to the waste-pile will be from each mill 268,800 pounds, and each will yield the same amount of net yarn—viz., 1,657,200 pounds.

For my Augusta mill I buy a water-wheel or wheels of say 200 horse-power, and rent my power from the Augusta Canal Company. The rent charge is five and a half dollars per horse-power per annum; so that for 200 horse-power I will have to pay $1,100 for a year. My water-wheels will certainly cost less than a 200 horse-power engine, with its engine-room, boiler-house, stack, coal-bunkers, etc. But let us claim no advantage in first cost of power. I start my Augusta mill by simply giving a few turns to an eighteen-inch wheel on top of my gate-shaft, and it requires no attention until the rest-time arrives about noon, when the same number of turns in the opposite direction shuts off the water and all is at rest. At Columbus, Ga., at the Eagle and Phœnix Manufacturing Company's mill No. 1, our water-wheels of 112 horse-power each made eighty-four revolutions per minute. So you perceive I get a higher first speed from water-power than I would like to exact from a steam-engine of the same power.

In this section of country it is almost true to say that the motion of the water-wheel is never impeded by ice, as it is elsewhere. Water-power is not considered by some as being as steady a power as steam. I think this must be a superstition. The water-wheel has a continuous circular motion. The steam-engine changes rectilineal into circular motion at every revolution, and if with only one cylinder, at every half revolution. How can a revolution with one or two dead points be as continuous as a circular motion without any dead points?

Next I go to start my steam mill—exactly like the other except as to power. I must hire a costly engineer, for I can not trust my fine engine and my dangerous high-pressure boilers, with all the interests dependent upon their continuous action, to a Jack Leg. I must hire firemen and coal-handlers, for I would need three, four, or five tons of coal daily, and its handling is laborious and must be paid for. Then I must buy, let us say, three tons of coal per day at a minimum for three hundred and ten days—say nine hundred tons yearly. For my water-wheel a few tons or a few cords of wood will keep me and my hands comfortable and my machinery protected. Are these differences insignificant? Suppose both my mills last twenty years, and that they both run all the time. I have to buy in the twenty years eighteen thousand

tons of coal for one mill and a few cart-loads for the other. If my engineer and firemen and coal-handling cost me in all $5 per day, I must pay out for this charge $1,550 per annum, and in twenty years $31,000. So, for these two items, I have to pay in twenty years $85,000 for one mill, while the other costs me for the same items *nothing*. It really seems as if "a masterly inactivity" is the true policy when one considers the propriety of starting the cotton manufacture at the North with steam; but, on the contrary, a very masterly *activity* at Augusta, Ga., and at many other points in this favored land of "Dixie."

Our mild climate and short winter enable the operatives to make themselves comfortable at little expense for fuel and clothing. They swarm to all new mills that are inaugurated, and think they are fortunate to find work. We have few strikes here; hardly any in my experience of nearly fifty years. The relations between the employed and the employers are almost always of a kindly character. If we had twice as many mills at work to-day in the South as we now have, employés could be found to take every position except for a time some especial departments of the work.

I have to buy 4,000 bales (1,920,000 pounds) of raw cotton for each of my mills. For the Augusta mill I pay probably fifteen cents per bale to get it from the Augusta market to my mill on the canal—say $600 in all. For my other mill I have to pay a small drayage here, and fifty-five cents per hundred pounds to get it from Macon (if bought here) to, let us say, Philadelphia; 1,920,000 pounds, at fifty-five cents per hundred pounds, costing me for freight alone $10,560 against $600 for my Augusta mill. If the same prices and the same rates should continue, my twenty years would net me an outlay for freights alone, without drayage, $211,200 against my Augusta drayage of $12,000, leaving a balance of $199,200 against my Northern steam mill as compared with my Augusta water mill; and adding the power items as above estimated, viz., $55,000 for twenty years, there has grown up a balance against steam of $254,200. It thus appears that, if both mills should endure for twenty years, I would have made a quarter of a million dollars more by staying at home than by wandering out in search of pastures new.

The account seems to be growing very large against my steam mill, but I am compelled to bring up other items against it. For instance, I buy the same quantity of cotton for each mill, and I choose to take fourteen per cent as the measure of waste in both mills, not quite believing that it should be so much. But the comparison is fair, as the amount is the same in both suppositions. Fourteen per cent of 4,000 bales is 560 bales, which I haul to my mill at Augusta at fifteen cents per bale drayage, or $84 in all,

and my waste goes to the waste-pile in Augusta. But I can not send my 560 bales of waste to Philadelphia so cheaply, but must pay the same rate as on raw cotton. My 560 bales weigh 268,800 pounds, and on this I pay fifty-five cents per hundred pounds to Philadelphia, or $1,478.40. Suppose this process to continue for a twenty years' life of the mill at the same rate of freight. At the end of twenty years I will have paid out to the Transportation Company $29,500 instead of $1,680 for my Augusta waste account.

I think, with Mr. Atkinson, that some very enthusiastic Southern spinners overrate the advantage the Southern spinner has in this respect. I doubt if it will average more than one half cent* per pound to the Northern than to the Southern spinner; and there are some very serious considerations, such as higher rates of interest, the absence of construction and repair shops, etc., which may considerably reduce any advantage we have now in cotton price. We are also at a greater distance from the large consuming markets, but the freight charge on the finished product is lower than on the raw material.

Last spring I was asked by a spinner what I thought would be the cost of changing half his spinning capacity from sixteen and twenty to number forty yarns. This is what must come in the not very distant future; and as the South advances to forty, the North must go to sixty, eighty, etc. The product of Southern mills can be made as perfect as that of any other section. Why not? The skill may be as great here as elsewhere, except for those branches of the work which are not yet attempted, but which will come in time.

Mr. Atkinson writes disparagingly of the longer working time in Southern than in Northern mills. He probably had not heard, when he penned his essay, that the Legislature of Georgia, at its last session, *fixed* the working time in cotton-mills at eleven hours per day. Many working folks North are clamoring for eight hours per day. I do not think eleven hours too much for a day's work in a comfortable mill, done by young people who can not elsewhere find occupation to give them home and subsistence. I do not think it injures them any more than ten hours would, and my experience teaches me that it is better to give them in their destitution the opportunity they are so glad to embrace. The mill working-day in Pennsylvania is, I believe, of ten hours' length. Here is another point of advantage which my Augusta mill has over my Philadelphia mill. I have ten per cent more working time, and of course produce eleven pounds of yarn in

* As this article goes to press the Macon Telegraph quotes middlings in Macon at 10¼ cents, and in Philadelphia at 11¼ cents, both on the same date—August 27th.

Georgia, while I make only ten pounds in Philadelphia. Is it not evident that to make my Philadelphia mill *equally efficient* with the other, it should have ten per cent more opening and carding power, more drawing, slubbing, roving, spinning, and finishing apparatus? Some people say that ten hours make as good an output as eleven; but don't they forget that the product depends upon the spindle revolutions at last? While the spindle revolves at normal speed, the twist must perforce go into the yarn.

A mill has just commenced operation here, in the outskirts of Macon, with English cards of fifty inches diameter and forty inches wire surface, with top flats instead of rollers. They turn off a little more than twenty pounds each per hour—two hundred pounds and more per day. The card-room machinery is of English make and functions admirably. The spinning machinery is of American make and is A No. 1. The product is very large, and the demand for it so great that I was informed recently that the mill was operated until 9 P. M. Most managers prefer American machinery. I do not, for the carding department. The American Robbeth spinning-frame seems to be almost beyond any further improvement. There is no objection to it, as far as I know, except that its cost is so great compared with the English cost of the same machine. I am told that these American spindles cost this Macon Company $3.30 each, while I have among my papers proposals for the same spindle in England at eight shillings (about $1.92 each). Most of the practical and skillful foremen are men of Northern training, and have very strong predilections for the machines they have been accustomed to, and many of them are only operators of mills, not constructors or owners. One gentleman said in my hearing some years ago, "No man can make money in this country with English machinery." I reminded him (it was in 1880) that the English had built forty millions of spindles for their own mills, and probably as many more for the rest of the world, while the United States had then only about ten millions; that some of the brightest intellects of England had been engaged for more than a hundred years in the invention, the construction, the operation, and the improvement of cotton-working machinery, and that they might be supposed to have reached results at least comparable with American results. He said no more.

Is it not ridiculous that people of sense say, after so long "protection," that they can not compete in price with English machinists—especially now, when I see the statement made that American iron can be sold in England from five to six dollars per ton cheaper than the English can make it at home? The manufacturers of the North and East generally seem to be unable to conquer their prejudices in which they have been indoctrinated

from their youth up. How forcibly Daniel Webster appealed to them to conquer their *prejudices!*

I have been informed that some people at the North anticipate a scarcity of operatives for newly inaugurated mills in the South, but the idea is new to me. In truth, so highly do I estimate the desirableness of this occupation, especially to the women and girls of these Southern States, that it has always appeared to me that this class of persons, if they understood the matter, would "cry aloud" for the repeal of the duty on imported cotton machinery; not on goods to be made in such mills, but on the machinery with which to make the goods. This duty is thirty-five per cent on the cost of the iron and forty-five per cent on the cost of the steel used in machine construction. Why should our machinists have this great prop to their business, while farmers, miners, and other workers indirectly pay the duties thus imposed? The farmers of the West pay under our system $345,000,000 annually, without any good to anybody. I quote from a remarkable treatise I read some years ago, by Alfred Mongredien, an English writer: "But this is called 'protection!' Phœbus! what a name! Protection for the very few American machine-builders, but destitution for hundreds of thousands of poor women and children who long for work but can not obtain it because the machinists are so much 'protected' that would-be mill projectors can not afford the high prices demanded for machines."

Just think of sulphate of quinine! A few years ago it was sold at six dollars per ounce at wholesale. The duty was repealed, and I understand that it can be bought now at some forty-five cents per ounce. Six dollars under protection; forty-five cents with competition open to the world. So with cotton-machinery: $1.92 per spindle in England, $3.30 per spindle at home!*

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* As I conclude this paper I am handed the inclosed slip, right to the point:

"CAN NOT STAND SOUTHERN COMPETITION.—Baltimore, March 29th. The cotton manufacturers of Baltimore are alarmed at the progress of the South in that branch of the national industry. One of them said to-day: 'We never cared for New England competition; it never cost us a thought. We sold, and still sell, more goods in Boston than we do in Baltimore. But it is the South that is hurting us. Since the opening of the cotton-mills in Atlanta, Ga., and other places in the South, our trade has fallen off twenty-five per cent. It is a mistake to suppose that those cotton-mills are hurting the New England mills. It is Baltimore that is suffering from their competition. They have the advantage of being right at the cotton-fields; they have unlimited water-power, and they have labor as cheap as and even cheaper than we can have it here. The children they employ work seventy-two hours a week, while the law here allows children to work only sixty hours a week. Of that, however, we do not complain, as we would not care to have the children work more than sixty hours.'

"The amount invested in cotton manufacture here is about $5,250,000, and the annual product of the mills amounts to $7,250,000. Over 5,000 hands are employed, who receive annually about $1,600,000 in wages. The cotton manufacturers of Baltimore held a meeting last night to discuss the situation."

INVISIBLE ASSAILANTS OF HEALTH.

By SAMUEL HART, M.D.

IN the natural competitive strife for existence among all organic beings, man had formerly recognized the fact that he was in direct antagonism with opponents which were formidable in proportion to their size, strength, and ferocity; and against whose aggressions he was to measure *force*, guided by his best intelligence. It has been, of course, a matter of common observation from most primitive times that some mysterious, invisible influence was constantly at war upon human life, but whose nature and intent were believed to be beyond permissible human ken. Scarcely a ray of light seems to have been shed upon this occult cause of human destruction until the present century; indeed, until within the last score of years. It is true, microscopy had been gradually unveiling to our astonished vision a new world, teeming with life of incalculable activity and scientific importance. But only recently have improved instruments and methods transformed a former invisible field into a true vivariuin of beings, each having its distinctive size, color, form, requirement for food and place, with its cycle of birth, life, and death peculiar to its species.

It is now understood that our material world, with its visible occupants, is supplemented by and interdependent with myriads of micro-organisms, permeating or enveloping all matter, and whose relation to organic life is essentially cosmical. In some of their multifarious forms they are the direct and only means and medium of transformation of material from its cruder form into the appropriate food for all organic beings; apparently having the power of wresting atom from atom in the mineral world in order to render it available for themselves as well as for plants and animals; thus performing a work purely beneficent and essential. Other forms of minute organisms are employed in the mutations of nature in undoing the work of the former; and, as if endowed with a spirit of maleficence, are occupied solely with the work of decomposing all organic substances, inducing decay and death.

These bodies are of the so-called low forms of life; impelled by natural necessities to provide for themselves where and as best they may. They are of independent vitality, each individual having its definite organization and requirement as to kind of food, temperature, and amount of light and air. They belong to distinct species, and are reproduced in kind, with as much exactitude in size and form as are the large plants and animals, both of which natural divisions they represent.

They increase with such amazing rapidity that, unless limited by want of nutriment and favorable environment, a single species would in a few years occupy the earth's surface to the exclusion of all other life.

Many species are of wonderful vitality and tenacity of life, and resist the extremes of temperature, of boiling and freezing. Others may be dried to an entire suspension of vitality for months and years; wafted here and there by the winds until, under favoring circumstances, they renew their wonted activity. Scattered on the snow of the hill-side, and carried down with the spring freshet, miles away, they may be swallowed with the water by some unfortunate individual, and perhaps prove their presence and their source by inducing in him an infectious disease of their specific kind.

The microbes may be captured, and cultivated on beds of gelatin, albumen, sugar, and in broth of meats; and under skillful management be made to furnish flourishing colonies and specimens of the highest degree of development. Or they may be starved and chilled to such helpless weakness and attenuation as to seem to lose their specific characteristics. Those we are considering are among the most minute bodies within the possible scope of microscopy. This, and their perfect transparency, have heretofore seemed an insurmountable hindrance to our further knowledge of them. But the discovery of their strong affinity for certain of the intense coloring matters has been fortunate and timely, furnishing a key to brilliant developments, since it is found that certain species show a predilection for special colors; and a particular part of the microbe, as its membrane, or its contents, may unite with the color, while other parts may totally reject it—thus giving, not only outlines, but illuminated internal structure, otherwise invisible and unknown.

The extreme minuteness, then, of these bodies has heretofore been the bar and hindrance to our better knowledge of them. But already we have been able to peer downward and inward, from gross visible matter, through organs, tissues, cells, nuclei, nucleoli, and granules, until, in the so-called *structureless protoplasm*, our present hunting-ground and limit, we seem to have reached the confines of the inorganic molecule and atom, which are subject to chemical instead of physiological law. The modern discoveries in this microcosmic realm, and the demonstration of the causative relation of micro-organisms to disease, upon which the "germ theory of disease" depends, stands so conspicuously as a scientific success, and is a step so important toward the alleviation of suffering, the prolongation of life, and enhancement of human happiness as to be the subject of universal congratulation.

In order to comprehend the importance of this subject, it must

be assumed that each of the long list of diseases known as *infectious* is caused by its own specific *virus*, and that no other material or combination of agencies can produce it. This fact is universally recognized. Furthermore, it has been demonstrated in a large proportion of these diseases that the essential principle of infection in the virus is the *living germ* called the pathogenic microbe.

The literally *vital* relation of microbic to human life can be observed in the following general statement: The pathogenic microbes cause four fifths of all diseases of the human family; they destroy more lives than war, famine, fire, murders, shipwreck, and all other casualties; and they actually abbreviate the average natural term of human life by three fourths, and constantly depress the health average of the world's population far below its natural standard.

They are an insidious but powerful and relentless enemy to human kind, holding sway over a large part of the most beautiful and fertile portions of the earth, excluding man at the peril of his life; while, as if with malicious discrimination, ferocious animals and venomous reptiles find there their congenial home, and vegetation reaches its acme of luxuriance. Like some diabolical spirit, in the form of the epidemic, it leaves its native habitat, and with insatiate malignity, sometimes with slow but irresistible progress, and again by rapid flight, passes all barriers of mountain, sea, and distance in its pursuit of man, its only known object, and whose destruction is its only visible effect. This is shown in Asiatic cholera, the plague, yellow fever, and the lesser scourges. The strife for possession in some coveted regions has been progressing for ages. Man may advance his outposts under the favoring light of sunshine, but must retreat, or fortify himself against the dangerous shades of night, until, by slow degrees, advantages are gained over the invisible enemy.

The Italian Pontine marshes, the jungles of India, the banks and shores of the tropics, our own Southern lowlands and fertile, new prairies are the strongholds of *Bacillus malariæ*.

"The pestilence that walketh in darkness, and the sickness that wasteth at noonday," are known to be the work of the armies of the microbes.

Some of the means and methods of the micrologist, in his researches, must be mentioned. His outfit is extensive and novel. It includes the best known microscopes and a well-constructed incubator with heater and thermometer, numerous test-glasses, beakers, filters, acids, alkalies, deep-colored dyes, and a good supply of prepared cotton.

In studying the life history of his microbes he will require a well-supplied commissariat. He must be a professional caterer

and a bountiful feeder. He must have fluids, semi-fluids, and solids, broths of various meats, peptonized food, the serum of blood, *à la Koch*, and Pasteur's favorite recipe with the French refinement: Recipe, 100 parts distilled water, 10 parts pure cane sugar, 1 part tartrate of ammonium, and the *ash* of 1 part of yeast. Among the substantials must be found, boiled white of egg, starch, gelatin, Japan isinglass, and potato—the last, from South as well as North America.

The appointments of his *cuisine*, and the extreme care and delicacy of manipulation required, will be shown in the preparation of a broth for the cultivation of a particular species of microbe. First, let it be remembered, all our surroundings are swarming with micro-organisms, a thousand times more numerous than the locusts of Egypt, and to exclude them from the kneading-troughs of the micrologist requires all the knowledge of the last quarter of the nineteenth century. A matter of the first importance, then, is that everything connected with the cultivation of microbes must be *sterilized;* which means that every microbe not wanted for observation must be destroyed; and no exorcism except by fire or the strongest antiseptics is found available. The preparation of a nutrient material for the cultivation of selected germs, according to Klein, will illustrate:

Place in a glass beaker fresh meat and water, equal weights; boil one hour; strain through a sterilized filter; after allowing the *bouillon* to stand for five hours, boil and filter as before. When cool, place in preserving glasses which have been sterilized by the flame of gas or the hot oven; then close by sterilized cotton, and boil again for *over thirty* minutes, and cover the mouth of the glass with an inverted beaker, one half filled with sterilized cotton, in order to effectually exclude the germ-laden air. Boil again the next day, and, when cool, place in an incubator for twenty-four hours at a suitable warmth, in order to hatch into life some possible germ of salamander endurance; and, finally, boil again for more than thirty minutes, in order to destroy this last suspected germ. If everything has been skillfully done, we have now a culture fluid exactly suited to the growth and development of a certain kind of germ only. These numerous steps and precautions for food-making may appear useless and absurd, but a little haste or a false step would undo the work of many days, and only this extraordinary attention to every detail has, after years of investigation, attended with acrimonious discussion among scientists, finally and forever settled the question of "spontaneous generation," as if in reassertion of the law that every living thing shall bring forth after its kind.

The method of demonstrating the germ cause of disease is as follows: Using only sterilized test-tubes, forceps, pipettes, cotton,

etc., take a particle of virus, known or supposed to contain pathogenic microbes, from a person suffering from an infectious disease, insert it by a delicate glass pipette through the sterilized cotton plug of a test-tube containing some of the prepared culture material, and deposit it there. Then place the tube in an incubator, warmed to the required degree, and let it remain for the number of hours suited to the peculiar requirement of its germ contents. By this means a vigorous progeny of one kind of microbe is obtained, while the tendency is to eliminate other kinds whose requirements are different.

But to further insure the exclusion of the ubiquitous horde, take out carefully a little colony of the vigorous microbes of the first culture through the cotton covering and place it in a new culture-tube with the same precautions as before, and so on, until, through high feeding of our test microbes and the adverse treatment of the others, we have, by microscopic tests, the thoroughbred, vigorous, and, may be, deadly microbe, which may be seen and every characteristic noted as to size, form, coloring, manner and time of development, all of which enable the observer to fix its classification. But the crucial test as to the relationship of a certain species of microbe to a particular disease is made as follows: Take, as above, the microbes from an individual suffering from a well-known infectious disease, cultivate them to complete isolation and perfection, and introduce them by inoculation into the blood or tissues of a healthy person. Here they must undergo a period of development or incubation, requiring just the number of days and hours as in the culture-tube. This fully developed disease must be strictly the same as that which furnished the test germs.

In making these experiments with the virus of dangerous diseases the human subject can not, of course, be deliberately employed; but casual inoculations and infections furnish opportunities for exact observation. A few enthusiastic pathologists and would-be martyrs have submitted to inoculations which have proved of scientific value. The inferior animals furnish much valuable material in this line, although they are entirely exempt from many diseases belonging to man; while in the human subject there seems a greater general susceptibility to microbic infection.

Founded upon the knowledge of the natural history of the pathogenic microbes has come the only scientific and satisfactory classification of the infectious diseases. It may be stated, as a rule, that the virus of infectious diseases originates either in the bodies of diseased living beings or in decomposing organic matter. When *the germs of the virus mature in the living being*, ready for reproduction in another person, they produce the *acute*

contagious diseases, including small-pox, chicken-pox, scarlet fever, typhus fever, relapsing fever, measles, miliary fever, influenza, whooping-cough, and hydrophobia.

In another class, called *miasmatic contagions*, the germs are propagated in diseased persons, *but, as a law of their further development*, they must undergo one stage of change outside of the body, in some decomposing organic matter, before they can again produce their peculiar disease in a healthy person, except by inoculation. To these *miasmatic contagious* diseases belong typhoid fever, yellow fever, cholera, diphtheria, acute consumption, cerebro-spinal meningitis, and erysipelas. When the virus *originates* entirely in decomposing vegetable matter, we have the *malarious* diseases: intermittent fever, remittent fever, continued malarial fever, pernicious fever, dengue fever, and chronic malarial infection.

Adopting this classification gives practical advantages without waiting for the demonstration of the particular microbes of each disease or their *modus operandi*. It is sufficient practically to know that the whole list of infectious diseases is accounted for under well-known laws of microbic generation. Indeed, the pathogenic cause may simply be called a *virus;* reserving only a distinctive character for each of the classes mentioned, viz.:

1. A virus which reaches full development in the diseased person, ready for infection in another, as in the small-pox class.

2. A virus which must be produced in the diseased person, but is not transmissible to another until after undergoing further development outside of the body; and usually in some decomposing organic matter. This is true of the typhoid-fever class.

3. Where the virus originates invariably in decomposing organic matter, and, after infecting the human subject, is never transmissible directly from one individual to another. This is the malarial class, including all the intermittent fevers, or the agues of slight degree as well as dangerous remittents and pernicious fevers, the intermittent neuralgias, and the "dumb agues."

Numerous other and very extensively prevalent diseases are known to be of microbic origin; among them pneumonia, rheumatism, tetanus, rabies, and the venereal in its numerous forms and phases.

Aside from the advantage of a scientific classification of diseases is that gained in the matter of prevention as well as cure; in both of which much has already been realized.

The means and manner of action of microbes in their destruction of life and health are various, and in some instances, as yet, obscure. As a prerequisite to their infectious development they must gain access to the blood or tissues through the cutaneous exterior or the mucous interior of the body; each species having

its peculiar site for ingress, its locality for operation, and its peculiar way of accomplishing the destructive work. Some produce harmful if not fatal changes in the blood by appropriating some of its vital qualities, leaving the system robbed and impoverished. Others seem to obstruct the minute vessels by their immense numbers, and thus do harm in a mechanical way. Some attack the blood-cells, penetrate their walls, and absorb their contents. Another and most important action of microbes is the production of poisons of deadly intensity, tending not only to the destruction of the infected person, but of themselves as well.

These products of the pathogenic germs, called *ptomaines*, seem to be the means of the suicidal limitation of germ-life in certain instances—where, having gained access to the healthy tissues, they flourish for a time, destroying as they go; but presently they lose their vitality, poisoned by their own venom, which may be sufficient in quantity and intensity to destroy the individual infected. This fortunate tendency to self-destruction of microbic life seems to belong to the infectious diseases.

A remarkable and important fact here is the exemption acquired by the individual once having a disease from all future attacks. The explanation is as yet difficult. By some pathologists it is supposed that the change in the system is due to the permanent retention of a sufficient amount of the ptomaines generated by the first microbic invasion to prevent a reintroduction of the same species. In that case the ptomaine would prove no hindrance to the successful attack of other species. Some suppose that an essential nutritive principle in the system becomes completely consumed by the first attack, and may never be reproduced to support a second one. But recent observations on the behavior of certain *cells* furnish a means, at once the most plausible and remarkable, for explaining the acquired disease-immunity, as well as a variable degree of original protection. These cells, called leucocytes and phagocytes, seem possessed of an instinctive, independent existence and behavior, suggestive of intellection. They are capable of locomotion, and a change of size and form—being constructed of elastic cell-walls of most filmy attenuation.

Their purpose, in part at least, seems to be to protect the system from harm within the blood, organs, and tissues. They are found where they may render the most ready and efficient service, particularly in the blood and in the air-cells and bronchioles of the lungs. Like a light guard in peaceful times, they are not conspicuously numerous; but in time of an attack they present themselves in great numbers and efficiency, and their energy in defense seems increased by any opposition not quite overwhelming.

The means of aggression or defense, as well as of sustenance, of the phagocyte, is by attaching itself to a particle of matter, and gradually surrounding and incasing it in its membranous walls until it is literally swallowed. If the particle should be a microbe, rich in protoplasm, it would be digested by the voracious and omnivorous *phagocyte;* but if of mineral origin, as dust of coal or sand inhaled by the lungs, it would be carried to the surface or to a safe receptacle, where the cell, having performed its mission, deposits itself, still incasing its burden. The phagocytes seem to meet whole broods of infective microbes which *may have* invaded the body, and destroy them, and, as it were, gradually acquire and permanently retain such efficiency as in future invasions of the same species to prevent any harmful action. The contest between these opposing forces does not always terminate with regularity as to time, as in the acute infectious diseases, but may become chronic, and the time and result uncertain.

In the slow, malarial diseases, according to this theory, the phagocytes finally acquire a domination more or less complete over the *Bacilli malariæ*; and this occurs not because the malaria has become less virulent, but because the phagocytes have acquired unwonted potency during the contest. This *acquired* domination of the phagocytes over one species of microbe seems not to be available against the inroads of other species. The exemption acquired in diphtheria and some other diseases seems partial as to degree and uncertain as to time.

One dreadful example of the failure of self-limitation of disease is found in hydrophobia. Here there is no natural stay or check to its fatality, and, although the most distinguished pathologists have given this question their best attention for many years, it seems questionable whether any life has ever been saved from hydrophobia. Large numbers of persons have been treated by inoculation for *supposed* hydrophobia, many of whom died, and the symptoms proved the hydrophobic cause; while in those who recovered no positive demonstration of true hydrophobia could be made, and the question of curability or prevention by inoculation remains undetermined.

M. Pasteur, the wizard micrologist, claims success in his battles with the rabies germs, and his brilliant achievements in other fields lend encouragement to expectant humanity. Jenner's vaccine discovery, by which millions of lives have been saved, encourages the sanguine belief that the principle of inoculation will, ere long, be made available for the preservation of countless human lives.

The method of M. Pasteur has been to obtain some of the positively fatal virus from the brain of a person or animal which

had died from hydrophobia, and to reduce the germs through numerous generations by a system of modifying treatment until they have lost, in some degree, their fatal virulence, while at the same time they may have retained a protective activity within the limits of safety.

In the warfare with the pathogenic microbes the idea of employing certain species as our allies, and opposing them against the very dangerous ones, is brilliant, and there are many facts encouraging the belief that the kingdom of the microbes may be further divided against itself, through the natural voracity of its numerous clans. Surely any tactics and every means, agressive and defensive, must be made available against an enemy so insidious and so formidable.

THE EVOLUTION OF CHEMICAL TRUTH.

By M. LOUIS OLIVIER.

IN his Lectures on Chemical Philosophy, J. B. Dumas has taken notice of the "singular contrast which is to be remarked among ancient peoples between the flourishing condition of industrial chemistry and the entire absence of theoretical chemistry." Empiricism, commanded by the necessities of material life, had, in fact, to precede the disinterested speculations of the reasoning powers. In this way the Phœnicians and Egyptians made discoveries of great significance in the arts of metallurgy, glass-working, and dyeing, without being guided by any scientific light. They interpreted them in a mystical sense, conformable to their religious conceptions of nature. Whatever we may think of their theories, we can not forget the positive bases of them; for the rational science of our century has been derived from their observations, winnowed by the ages. The facts have resisted the assaults of time, while the magic, the theurgic doctrines, found to be sterile, have gradually disappeared to give place at last to the fruitful idea of natural laws. It was a curious metamorphosis, in which astrology, alchemy, and the old medicine predicating the virtues of stones and talismans, mark the transition from the ancient to the modern mind.

It is with great interest that we follow with M. Berthelot * the evolution that has thus taken place in chemistry from the ancient Orientals to the Greeks, and from them to us; for it is associated with the development of philosophical ideas, consequently with the history of the human mind. From the time when alchemy

* Les Origines de l'Alchimie (Origins of Alchemy).

in a somewhat sudden fashion made its appearance in the world, till the moment of the fall of the Roman Empire, we know very nearly what it was, but are hardly certain whence it came. The study of which we are about to give an account assigns for it a triple origin: the industrial processes of the ancient Egyptians, the speculative theories of the Greek philosophers, and the mystic reveries of the Alexandrines and Gnostics. This conclusion is derived from the attentive examination of documents that have not been studied before with this point in view; among which are Lepsius's memoir on the metals in antiquity, Egyptian papyruses in Paris and Leyden, and Greek manuscripts in the French National Library and St. Mark's Library in Venice. M. Berthelot has compared with these texts, on one side, the beliefs of the first alchemists concerning the origin of their art; and, on the other, their positive knowledge, as well as the theories accepted in the second and third centuries of the Christian era. The deductions from these different sources are quite concordant.

Zosimus the Panopolitan, "the oldest of authentic chemists," wrote, three hundred years after Christ, that "the Scriptures teach that there is a certain race of demons that have commerce with women. Hermes has spoken of them in his book on nature. The ancient and holy Scriptures relate that certain angels, smitten with love for women, came down upon the earth and taught them the works of nature; on this account, they were driven from heaven and condemned to perpetual exile. From this intercourse sprang the race of giants. The book in which they taught the arts is called *Chema*, whence the name *Chema*, which is applied to the most excellent art." This idea of sinning angels who revealed the occult arts and sciences to mortals, is found in several countries. It is "in harmony with the old biblical myth of the tree of knowledge placed in the garden, the fruit of which when eaten brought about the fall of man."

The Theban papyruses at Leipsic attribute the same mystical character—a kind of seal of its Eastern origin—to alchemy. It was Hermes Trismegistes who made known practical metallurgical processes, the *hermetic science*, the mysterious art of transmutation. The Egyptian priests, who were instructed in it, had to take an oath to keep the secret of it. This custom was preserved among the Neoplatonists and magicians of the fourth century, and the alchemists of the middle ages and the Renaissance.

Many of the traditions held in honor among the alchemists seem to have been borrowed from the Theban priests. The number four was sacred with both. The philosopher's stone was called the Egyptian stone in the middle ages. The alchemic sign for water was the hieroglyph for that substance. The sign for tin, which has been transferred to the metal mercury, was also

the hieroglyph for the planet Mercury; and a similar identity is observable between the sign for gold and the hieroglyph for the sun. Osiris was the synonym for lead, sulphur, etc.

This mystic relationship of the metals and the planets goes back to the Babylonians, and the idea was perpetuated. Pindar mentioned the relation between gold and the sun; and Proclus, in his commentary on the Timæus, wrote, "The sun produces gold, the moon silver, Saturn lead, and Mars iron."

The symbol for the philosophical egg appears to have originated in Chaldea, and to have been introduced thence into Egypt. So was the idea of the microcosm made in the image of the macrocosm. Thus the Babylonians and the Greeks of Egypt, as well as the Alexandrians and the Chinese, held to these aphorisms, afterward so dear to the alchemists, concerning the generation and transmutation of metals, the panacea, and the elixir of long life.

Traces of Jewish traditions, mingled with Eastern fables, can be found in some of the alchemic beliefs of about the eleventh century. Several papyruses mention important receipts as included in the pretended Secret Book of Moses; a Greek manuscript of St. Mark's represents Mary the Jewess, to whom the invention of the water-bath is attributed, as saying: "Do not touch the philosopher's stone with your hands; you are not of our race, you are not of the race of Abraham." According to Zosimus, the sacred art of the Egyptians and the power of gold that resulted from it were delivered to the Jews by a fraud, and they revealed them to the rest of the world.

This confluence of the Chaldo-Egyptian and Jewish sources of alchemy took effect in the first three centuries of Christianity, or at the time when Gnosticism was flourishing at Alexandria. The first alchemists seem, in fact, to have nearly all fallen under the influence of Neoplatonism and Gnosticism. The symbolical forms of universal life, the allegorical figures in which the philosophical sense of things was hidden, were abundant in their writings; and here and there in them we meet all sorts of Gnostic signs, from the image of the world without beginning or end, represented by the dragon Uraboros, a serpent biting his tail, to the eight-rayed stars and magic circles of Cleopatra's "chrysopæus." The introduction of Gnostic ideas into the theories of the alchemists undoubtedly accounts for their inclination to explain the hidden properties of nature by signs of double or triple meaning.

The same tendency is evident in the Greek alchemists, whose memory has been preserved by the ancient manuscripts. The St. Mark's manuscripts cite as among the most famous of these, after Hermes, John, Arch-priest of Thutia, and Democritus, the celebrated philosopher of Abdera. But they also introduce to us

Zosimus, the experimenter, the historian and biographer of Plato, Olympiadorus, and Stephanus, authors of important memoirs on the art of making gold. For that purpose they employed, according to the manuscripts, a projecting powder endowed with the mysterious power of impregnating bodies. This powder was prepared in the Thebaid, at places which, according to Agatharcides, were centers of metallurgical enterprises.

In the ninth century all the documents are found in the hands of the Arabs, who became the depositories and continuers of Grecian science. Mussulman civilization has handed down to us the history of the mythic alchemists, their mysterious formulas, and the practices which they adopted for blanching and yellowing metals—that is, for changing them into silver and gold. In their conceptions of matter, the Arabs of Spain and Syria followed in part the philosophical systems of pagan Greece; and their authors freely quoted Aristotle, Heraclitus, Xenocrates, Diogenes, and Democritus. The story of their doctrines and brilliant discoveries is told in all histories of chemistry.

M. Berthelot's detailed review of the positive facts which alchemy received from antiquity makes it manifest that Egypt left an inestimable treasure to the world. The priests of Thebes and Memphis made great advances in the knowledge of the art of extracting metals, of forming alloys, and of making vessels and tools out of them. They distinguished crude gold from refined gold, and could work that metal up into a variety of articles. They fed the hope that they might be able to obtain it by coloring *asemon*, or silver, yellow. Of the latter metal they made money, the value of which was guaranteed by an impressed image. They extracted gold and silver from *electrum*, a mineral containing both substances, but which presented to their eyes the appearance of a metal like them. This was what led them to the notion of transmutation.

The Egyptians designated as *chesbet* several kinds of blue or green sapphires colored with cobalt or copper. They made incrustations, amulets, necklaces, and various ornaments of them. They succeeded in compounding an artificial chesbet resembling the natural stone. A fact worthy of remark in the matter is, that this was done by "the assimilation of a colored substance, a precious stone, an enamel, a vitrified color, with metals." This assimilation suggested the new idea of dyeing; "for the imitation of the sapphire rests on the coloring of a large mass, colorless by itself, but constituting the vitrifiable basis, which we dye by the aid of a small quantity of coloring matter. With enamels and colored glasses thus prepared, the natural precious stones were reproduced; they were covered with figures, with objects of earth or stone, and were incrusted with metallic objects."

Among the minerals and metals known to the Egyptians are also mentioned the emerald, malachite, copper in alloys, iron, lead, tin, and mercury, the mobility of which caused it to be regarded as living; whence the name quicksilver. Their tinctorial art included dyeing in yellow, white, and black; and they could also dye purple by means of alkanet and archil. All these changes brought about in the appearance of bodies seemed to be modifications of their properties, and consequently to legitimize the expectation of effecting transmutation. We should, however, recollect that the idea of the fixedness of the properties of bodies is wholly modern. Even Bacon wrote in the seventeenth century: "Observing all the qualities of gold, we find that it is yellow, very heavy, of a certain specific gravity, malleable, and ductile to a certain degree; and whoever is acquainted with the formulas and processes necessary to produce at will the yellow color, the high specific gravity, the ductility, and knows, also, the means of producing these qualities in different degrees, will perceive the means and be able to take the measures necessary to unite these qualities into a definite body; and from this will result its transmutation into gold." This was, in fact, the dream and the mastering passion of the alchemy of the middle ages and the Renaissance.

These conceptions were very ancient, and must be looked for in their original forms in the Greek philosophy. The germ of the doctrine of transmutation is in the Timæus. It rests on the idea of primitive matter, the indifferent supporter of all the qualities that can be heaped upon it. Plato insists upon the idea, which he regards as fundamental, that "the thing which receives all bodies never comes out from its own substance. It is the common basis of all the different substances, and is deprived of all the forms which it would receive otherwise." The primary matter was supposed to be composed of fire, which made it visible, earth, which made it tangible, air, and water, which assured the union of the earth and the fire—these four elements being formed of minute corpuscles, susceptible of changing into one another; for we see, says Plato, "that water, in condensing, becomes stone and earth, and in melting and dividing itself up, becomes wind and air. Air inflamed becomes fire; fire, condensed and extinguished, resumes the form of air; air, thickening, changes into mist, and then flows as water; and from water are formed earth and stones."

All bodies were believed to be the seat of a transformation of this kind. Under the influence of this thought, Proclus wrote, "Things being never able to preserve a nature of their own, who shall dare affirm that one of them is this rather than the other?" It is, therefore, by virtue of a necessary law of nature that bodies

are modified, and transformation is possible. This determinist conception was afterward mingled in the minds of the alchemists with Oriental mysticism; but it must be remarked that it presented, in the Greek philosophers Thales, Anaximenes, Heraclitus, Empedocles, Plato, and their immediate heirs, a really scientific character. Michael Psellus was faithful to their doctrine when he wrote to the Patriarch Xiphilin, in a letter which was used as the Preface to the Collection of the Greek Alchemists: "The changes of nature are made naturally, not by virtue of an incantation or a miracle, or of a secret formula. There is an art of transmutation. . . . You want me to teach you the art that resides in fire and furnaces, and which produces the destruction of substances and the transmutation of their natures. Some believe that this is a secret knowledge, gained by initiation, which they have not tried to reduce to a rational form; which seems to me an enormous error. For myself, I try first to learn the causes, and to deduce from them a rational explanation of the facts. I sought it in the nature of the four elements, from which everything comes by combination, and to which everything returns by solution."

From Greece alchemy then received, with the idea of a primary matter and the system of atoms, a whole contingent of rationalistic notions which subsequently modified more or less Christian mysticism and the traditions of the East. The effort of the alchemists of the middle ages to divest the metals of their individual qualities in order to reach the primitive matter, the mercury of the old philosophers, was then in harmony with Plato's metaphysics. But, in the operations they performed for that end, they could only determine the indefinite transformation of the elements, and they represented the mysterious process under the symbolical form of a ring-serpent which has neither beginning nor end. This hopeless picture of chemistry did not cease to be true till the end of the last century. By introducing the balance into laboratories, Lavoisier demonstrated that the weight of metals is invariable, and, in a general way, that the origin of all chemical phenomena lies in the reactions of a small number of undecomposable bodies, the weight and properties of which are constant.

This great discovery sapped the alchemic doctrine of the transmutation at its very foundations. It is, however, still permissible to ask if the present elements, as yet undecomposed, are really simple bodies. If Prout's hypothesis that they are polymers of hydrogen could be demonstrated, the hope of passing from one to the other would be entirely legitimate. But the recently carefully made determinations of the equivalents of simple bodies by Dumas and Stas have weakened that theory. The laws of specific

heat, moreover, do not permit us to see in our present simple bodies polymers of the same substance comparable to known polymers. The specific heat of the last increases, according to Woestyn's law, with the complex structure of their molecule, while the specific heat of simple bodies varies, according to Dulong and Petit's law, inversely as their equivalents.

We may, nevertheless, conceive the unity of matter in another sense. Some chemists oppose to Prout's hypothesis a new and more comprehensive one, which consists in regarding the elements as states of stable equilibrium in which matter exhibits itself. "In this order of thought," says M. Berthelot, "a body reputed simple could be destroyed but not decomposed in the ordinary sense. At the moment of destruction it would at once transform itself into one or several other simple bodies, identical with or resembling the existing elements. But the atomic weights of the new elements could not offer any commensurable relation with the atomic weight of the primary body from which they are produced by metamorphosis. More than this: by working under different conditions we might see appear sometimes one system, sometimes another, of simple bodies, developed by the transformation of another element. Only the absolute weight would remain invariable in the course of the transmutations."

Even under this hypothesis the hope of forming simple bodies need not seem chimerical. Unfortunately, we have no more reasons for encouraging it than for condemning it. All that can be said respecting it is that the present condition of science does not allow us to discern any method that will lead to the end. Would it not be wiser, then, to make our theories more complete rather than venture into this darkness without a guiding thread? It is no mystery to any one that they greatly need improvement. The imponderable fluids have only just passed away; the ether, too, seems to be already withdrawing, taking along with it, perhaps, the atom of the chemists; and does it not seem that everything is about to be explained by motion?

M. Berthelot discusses these questions with his well-known vigor and originality. His work, erudite and pointed, is particularly instructive to the thinker. He in fact restores to our view the affiliation of the systems that were conceived at the birth of chemistry, and which have been revived at our time in the effort to resolve the eternal problem of the constitution of matter.—*Translated for The Popular Science Monthly from the Revue Scientifique.*

IRRIGATION IN CHINA.*

By GENERAL TCHENG KI TONG.

I PURPOSE to describe what has been accomplished in utilizing the natural waters in our country, where for four thousand years we have sought to get all we could out of them. By means of economical utilization our lands, notwithstanding the extraordinary multiplication of our people, have furnished us ample supplies of food. One of our proverbs says, "Always have children; Providence, which brings them to light, will not let them die of hunger." You never see insects, creatures of nature as we are, dying of hunger; why should men suffer more from it than these little ones? Every one, therefore, ought to find support on the ground he lives upon; but to do this we must take advantage of all the circumstances. If the ground is not sufficient for our wants, we should add to it the fruitfulness of water, subjected to our use. While the Western people have done much to utilize water wherever it seems available, there are, to my view, many defects in their management. I believe water is made to be used everywhere, and yet, notwithstanding the progress of science, this rule is not always conformed to in the West. With all their engineering works, well-water fails in the large cities, and that from the rivers has to be used. It is impure, and consequently unwholesome. In China, where we have had the same difficulty to contend with, we applied the remedy long ago by always boiling such water previous to using it—applying the anti-microbic remedy before the existence of microbes had been scientifically determined.

The efforts of our ancestors to subject the waters to their use date from an enormous antiquity; I have documents that show how this was done forty centuries ago. Notwithstanding the numerous modern inventions to facilitate the labor and manipulation, we have resolved the most difficult problems in such a manner that nothing can be shown to this day that surpasses what has been accomplished among us by the most primitive methods. By virtue of our system of irrigation our fields give us three crops a year without asking for any intervals of rest. Our liberally watered land is like a peasant woman ignorant of the refinements and weariness of the society woman, whose children follow one after another in the regular order of nature. This comparison may seem a little vague; but in China we believe that the sky is masculine and the earth feminine; that the one acts and the other produces; and that all fertility is the result of the

* An address, delivered July 26, 1889, before the Congress for the Utilization of Waters.

close union of these two constituent elements of our world. That is the fundamental idea of our agricultural and hydraulic philosophy.

The distribution of water by canals dates, in China, from the fabulous epoch. Having been carried on before letters and literature existed, we do not know what method was at first employed. In the year 2300 B. C., according to our annals, in the reign of the Emperor Yao, China was visited by a deluge extending over the whole empire. It lasted nine years, during which the whole country was a submarine domain. The waters of this flood were drained away by the enterprise of the Emperor Yu, our Noah, who employed seven years in dividing the country into nine regions, separated from one another by artificial water-courses which were like natural frontiers. After the water had been withdrawn he had the qualities of the lands of each province examined, and the products ascertained which they could afford; established the unit of land measure, and fixed nine classes of imposts, graduated according to the fertility of the lands and their situation. The conditions thus established lasted ten centuries.

In 1100 B. C. the prime minister of the Emperor Wou-Weng, Tcheou-Kung, constructed *norias*, or hydraulic machines of simple design and working, by which water was raised to a height to which it had never been carried before, and made reservoirs and canals for irrigation. Water was conducted, by means of machinery, from the wells to the dry hill-tops, and water provision was assured for times of drought. Agriculture, in consequence, flourished. Other measures of Tcheou-Kung comprised the promulgation of laws respecting the boundaries of properties and the prevention of trespasses. The fields were divided into squares called wells, from their resemblance to the Chinese character signifying a well, surrounded and furrowed by ditches so arranged that eight farmers, each tilling his own tract, united in cultivating the ninth, interior tract, which belonged to the state, and the produce of which paid their rent.

The system succeeded to a marvel. Each tenant was proprietor of about fifteen acres, the whole product of which belonged to him, while the state was really proprietor of the whole, and had, as a landlord, the income of the ninth tract. Besides this, each farmer had some 3,350 square metres of ground for his farm-yard and his mulberry-trees. Thus he always enjoyed a surplus of provision, of pork and poultry for food, and silk for clothing. No one at this time was richer or poorer than another, but a complete social equality existed, and every one, they say, was satisfied. The dynasty under which this system was established fell into decay about 600 B. C., when a period of feudal oppression set in that lasted for two hundred years. At the end of that time

Prince Houan-Kung, having obtained the supremacy in the kingdom of Tchi, returned to the system of Tcheou-Kung in a modified form. He appointed a minister and other officers of waters, who visited all parts of the country and attended to the execution of the works needed to prevent the visitation of the two great scourges of drought and floods. By these energetic measures the kingdom of Tchi was made the richest state of the time. When the Emperor Tsing-Tse-Houang, B. C. 250, reunited the Chinese Empire, he made the lands free to all, and imposed a tax instead of the cultivation of the ninth for the state. Previous to this he had constructed the Tcheng-Ko Canal, to conduct water from the King River to the Pe Mountain, by the aid of which some nine hundred thousand or one million acres of formerly sterile land were made fertile, so as by its increased wealth greatly to aid him in transforming his kingdom into an empire. Unhappily, he was dazzled by his great success. He allowed the canals to be neglected, and the country in consequence fell from its high estate of prosperity; and, as it is related in one of our historical books, "the dynasty of Tcheou, who founded the method of well-lands, survived for eight hundred years, with a happy people and prosperous landholders. Tsing followed an opposite policy, neglecting the canals; and his family only reigned for two generations, because so many of his people were ruined and their hearts were turned away from it." Thus the utilization of the waters had become a great political factor. This is not strange, because the Chinese are eminently an agricultural people. The system of Tsing was continued, except that the rate of taxation was reduced, under the Han dynasty, which arose 202 B. C. But after about three hundred and fifty years a series of inundations—the first that had occurred in two thousand years, or since Yu's time—began in the Yellow River and resisted all attempts to check them until a thorough method was adopted, under the direction of a special minister of hydraulic works. At the same time the productiveness of the land reached by the new canals was greatly increased. In the regions distant from the rivers irrigating wells were dug, and a period set in of activity in hydraulic works and general use of water which has not been surpassed.

The success of the proprietors who enjoyed the advantages of the irrigation works encouraged others to construct similar ones, each according to his means and for the advantage of his tenants. This method differed from that of Tcheou. The distribution of the lands was more unequal, but the regulation of the waters had been so perfected that the agriculture of the kingdom received a decided impulse; and China still has reason to thank the authors of the transformation for the permanent benefits it

has conferred. The works were extended and added to from time to time, and the construction of the canal Pé gave origin to a popular song celebrating the benefits derived from canalization. The transportation of rice by these artificial channels dates from the third century, when the Emperor Min-Te had a canal constructed which added more than 300,000 acres of land to cultivation and was used for the transportation of arms and provision. From this time there was more than enough food in China.

The efforts of the Thangs in the sixth century were less remarkable than those of their predecessors, because the more important enterprises had already been executed. The most noteworthy of these was the excavation of a lake in 624 A. D. by the celebrated poet Pe Ku I, who was also a prefect. It was supplied by the Tsien Tang River, and watered a space of between 90,000 and 100,000 acres. The dam was solidly built, but permitted the water to filter through in such a way as to fall slowly on the land below the level of the lake. The bank, planted with peach-trees and weeping willows, became a favorite promenade for *literati* and poets. The lake was crossed by six bridges, beneath which the flowers of the lotus waved, and the promenade was the first water-side pleasure-walk that existed in China. This lake was enlarged under the Sung dynasty by the poet Sou-Tong-Pao, who added what is called the outer lake. New dams were built, and travelers who resort to the lake are still able to admire the beautiful as well as useful work of the two great poets, who enjoyed also the rare privilege of being great engineers.

The Sung dynasty, in the ninth century, desiring largely to extend the system of canals, created a new department, at the head of which was placed a minister called the Governor of the Waters. Besides this, a superintendent of the transportation of rice was appointed to administer the northern provinces of the Yellow River, to whom were assigned the study of the regimen of the waters and the food-needs of the provinces, the classification of productive lands according to their value and position, and the supervision of the mulberry culture. This was the second period of Chinese agricultural prosperity. Another improvement was introduced in the tenth century, when sluice-dikes were invented which could be closed in times of flood and opened in dry seasons.

An overflow of the Tai Hu River in the province of Su Chiu, in 1160, moved the censor Li Kie to propose three projects to the throne: To make sluices and dams; to establish competitions among officers and others in plans for hydraulic works; and to take advantage of the fall and winter seasons of low water, when the people were not engaged on their farms, to employ them in constructing the works. The propositions were accepted, and the

works constructed in pursuance of them proved to be of great practical value.

The first emperor of the Ming dynasty, in 1360, gave orders to have the obstructed canals restored and reopened, so as to show that his first act was to think of the food and clothing of his people. When another flood occurred in the reign of Yung Lo, the work of repairing damages and providing permanently against future disaster was carried on day and night under the direction of the Minister of Finance, who mingled with the people and shared their labors. Under another emperor the very difficult and expensive works of what is called the "canal of multiple benefits" were completed, so as to furnish water to more than a million acres. The present dynasty, besides continuing the work of maintaining the canals, has published, under the Emperor Kien Lung, in 1737, a grand encyclopædia of agriculture and horticulture in seventy-eight volumes. The preparation of the work was intrusted to agriculturists and *literati*, who were careful to announce in the introduction that they had no intention of promulgating new ideas, but only to collate the most valuable methods and observations contained in the former works of the wise men of the empire. This cyclopædia is a store-house of valuable information concerning the utilization of water, and demonstrates the advance which the Chinese had made in extreme antiquity in that important branch of agriculture.

My country is essentially agricultural, and, in order that agriculture might prosper, we have applied ourselves, as you see, to give the land drink. The Emperor Yu, after he had delivered us from the flood, planned courses of water to flow over the land, as the Creator has furnished us with veins carrying the blood through our bodies. Confucius, speaking of Yu, said that all his efforts could be summarized in the creation of the canals. They were the motive force of the empire, and also an effective means of diminishing the destructive action of torrents and avoiding inundations. These prosperous times have continued the model and the ideal of China. The successors of Yu, whenever they deviated from the road that he marked out, saw all their dynasties extinguished in consequence of disasters caused by their neglect. The people have contributed their part to the depreciation of the water system. They have set water-plants on the water-sides to strengthen the marshy soil and gain new tracts of land, whereby the fields have been enlarged at the expense of the canals, while the farmers have not taken heed of the contraction of the liquid arteries. Then, in time, the water, not having sufficient outlet, would overflow. Our efforts are now devoted to making such things impossible, and to preventing the canals being obstructed by the encroachments of the land.

But while our farmer has the fault of trying to get too much out of water's-edge plantations, he is distinguished by many economical qualities. He has infinitely multiplied the branches of the artificial rivers that the wisdom of our emperors and their ministers has created; rich in numerous children, he has used their hands to subdivide the ditches and drain them through thousands of irrigating rills; and, in consequence of the constant presence of the precious liquid, he has realized prodigies in crops. Water permits him to use natural manure diluted to the fifteenth, according to the precepts of our sages, and to return to the land what man has taken from it. Water, always abundant, has furnished the means of applying the method of transplanting to the cultivation of wheat, and thereby getting larger returns; and it has made the constitution of small properties possible, and extreme subdivision of the land by which an intensive cultivation is secured for the smallest parcel. It is true that other factors, the patience of our peasantry, the wise organization of our mutual banks, and our inveterate habit of spending our money on the ground, have contributed much to our agricultural prosperity; but all these would have amounted to little in comparison if they had not been supplemented by the vast irrigating works.

I will add that without these gigantic works the Chinese could never have reached the high degree of perfection they have attained in one of the most important of their industries—pisciculture. Through the abundance of water everywhere, my countrymen, instead of being satisfied to cover the sea, rivers, and lakes with their fishing-boats, have been able to devote themselves extensively to the raising of fish. The spawn is carefully collected wherever it is found; instead of abandoning it to the channels of the rivers, the watchful shore-dweller puts it under protection wherever a suitable supply of water is to be found. The irrigation reservoirs are swarming with young fish. The fallow rice-fields, dammed and flooded in winter, are alive with wriggling carps; and even the rain-water cistern is turned into a breeding-pond.

This economical management permits us, without pisciculturul societies, to stock the rivers with millions of fry, and to add a considerable variety of fish to our bills of fare, a part of which is consumed fresh, while the rest, salted or dried, is dispatched into all parts of the empire and sold at a moderate but always remunerative price.

As a whole, our system of water regulation may be regarded as one of the greatest achievements of the intelligence and labor of men. To it China owes very largely the comfortable condition of its innumerable inhabitants. It is not perfect, for it still leaves much to be desired; but we know well what is wanting,

and what must be done to supply it. If we had fancied that there were no defects in it, recent events, including the irresistible and disastrous overflows of Yellow River, would have demonstrated the contrary. They teach us that unceasing vigilance must be exercised in keeping the artificial waterways open, and that additional works are needed to make the system complete.

A difficulty resulting from the special character of our social organization stands in the way of the execution of new works. The whole of our territory is under cultivation. There is not a corner of the land capable of producing a crop that has not been devoted to some profitable occupation. To construct new canals, enormous sums additional to the expense of labor—very considerable at the cheapest wages—would have to be applied to the indemnification of dispossessed proprietors. There is also considerable diversity in the plans that are under consideration. Some favor the addition of new canals to the old ones. Others prefer vast basins, artificial lakes for the storage of the water of freshets, whence it may be drawn when wanted, to distribute over the country fertility instead of desolation. Formidable as the obstacles to immediate execution may be, we can foresee the time when these great works, indispensable to the completeness of our hydraulic system, shall have been brought to a good end. Then China, endowed with the grandest system of water distribution that the world has ever seen, will have nothing to do but to keep up the good condition of the work of the ancients with its modern additions.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

RICE AND ITS CULTURE.

By L. W. ROBARTS.

THE rice-plant (*Oryza sativa*) is a member of the grass family, and furnishes one of the most valuable grains known to economical science. It is cultivated, by the aid of abundant irrigation, in numerous varieties in most warm countries, and in the East Indies and China constitutes the principal food of hundreds of millions of human beings. The grain is also applied to mechanical uses in the arts, and the straw is one of the most highly prized materials of that class.

Ages before the discovery of America rice was cultivated in India, and is of volunteer growth in many parts of that country, "but principally on river-banks, where the seed was perhaps let fall." There is a wild rice preferred by the wealthy of Hindostan, but, on account of its small yield, it is not much grown.

There is no certainty of the place of the nativity of this valu-

able grain. The Chinese have much improved it by selection, which practice was in early years enforced by an imperial edict requiring the planting of only the largest grains. The most valuable variety grown in this country was secured by a South Carolina planter, who, upon observing some notably long grains upon a head, secured them, and so obtained the kind called the long grain. In the island of Ceylon there are one hundred and sixty-one varieties.

Various accounts are given of the introduction of rice into this country: one, that it was brought from the island of Madagascar toward the close of the seventeenth century, and planted in a garden in what is now one of the most thickly settled parts of the city of Charleston; and from this came the seed "that has made South Carolina the great rice-growing State." Another account claims that it was first grown in Virginia by Governor Berkeley, of unenviable fame, as early as 1647.

There are three varieties in the rice-growing States: 1. "White rice, valued for its earliness and for growing upon uplands, the husk cream-colored, and an ounce containing nine hundred and sixty grains. 2. The gold-seeded, with a deep-yellow husk, and large, fine white grain, eight hundred and ninety-six grains to the ounce. 3. The long grain, a sub-variety of the gold seed, having eight hundred and forty grains to the ounce; the grains are longer than any other, and it is the most valued for cultivation: for home use a long-awned variety, called the white seed, is often sown."

It is of the rice-fields of the tide-lands of the Georgia and Carolina coast, and of the adjacent islands, that we would speak. To those who have never been among them, these rice plantations would afford much that is both novel and interesting. This evergreen region, where the plaintive notes of the whippoorwill and song of the sweet-throated mocking-bird float up through the moss-covered trees; and negroes, fever and ague, rice-birds and alligators abound, would indeed seem to be a new world to our Northern brethren, and the picturesque effects charm the eye of the stranger artist. The rice-field darkey is himself a distinct type, totally different in both aspect and dialect from the negroes of the interior; and a not uninteresting sight is the force, as with song and shout they take their way along the embankment to the rice-field. Their ancestors for generations back, or, as they would tell you, "mi farrar an' mi granfarrar," have lived and labored in these malarial regions, and they accept chill and fever and other infelicities incident to these localities as unavoidable evils, plodding on with no higher aim nor hope, careless for the future, and not over-anxious for the present. The cost of living is small, as not many nor very warm garments are considered necessary, and the rice-field darkey's ideas of a wardrobe are extremely limited,

from both blissful ignorance and choice. Fish and game are plentiful, and in these regions a heavy diet is to be indulged in only at great risk. Free labor is found to be more remunerative than slave, inasmuch as the idle or inefficient can be dismissed; and the rice-planter of to-day has not necessarily the care of the sick nor the doctor's bills of the *ante-bellum* time, when the very best physicians were employed. Then, again, there is the wonderful relief from anxious care; and the providing in every way for the wants of a large plantation of negroes, great and small, was no sinecure.

The best rice-lands are on the banks of rivers, for the convenience of flooding by the opening of the tide-gates, and also of conveying the grain to the mills. They must be so situated as to escape the salt and brackish water, but be below the reach of freshets, which are often most disastrous. They are alluvial lands, composed principally of decomposed vegetable matter, and when dry have the appearance of soot. Good crops can be made on other low lands, if so lying that they may be drained and flooded at will. These plantations have been and still are valuable possessions. It costs no inconsiderable sum to get them in order for planting, though less than formerly, as the planter of to-day cultivates fewer acres. The land is regularly laid out by a complete system of embankments and ditches, forming independent fields—the size of the fields being limited by the number of hands that can finish one day's necessary work of cultivation in a day, usually from fourteen to twenty acres.

The plantations are surrounded by a dam or levee, with floodgates and trunks, through which they are irrigated from the river. They are divided in squares, banked in, with a large ditch near the banks, which receives the water from the trunks for irrigation through smaller ditches fifty feet apart, through which the fields are also drained at ebb-tide.

Rice Culture.—Early in the winter the water is all drawn off, that the banks may be strengthened, ditches mended, and the ground plowed or hoed. In warm changes the water is again turned on. In March drains are cleansed, ground kept dry, clods broken up, and all made smooth with harrow or hoe. In April, and until about the middle of May, the grain is sown in trenches, a four-inch trenching-hoe being used, running at right angles to the ditches, and about sixteen inches apart. By some the fields are cross-plowed, and the grain dropped at the intersections. The seed is very carefully selected, and sometimes, in order to secure only the fullest grains, the rice is thrashed by hand over a log or barrel. The seed, when sown, is lightly covered, and the water turned on and kept upon the field from four to six days, until the grain swells and begins to sprout. If the seed is not to

be covered, it is mixed with clayey water and dried, when a sufficient quantity of clay adheres to prevent the grains floating off when flooded. With the first method the water is again turned on in the "sprout-flow," when the plants sprout "and appear like needles above the ground"; with the latter one flooding is sufficient. When the water has been on the sprout from four to six days, it is again drawn off; and when the plants are six weeks old, they are lightly hoed, and the hoeing is repeated in ten days.

Now comes the stretch-flow, when the young plants, several inches high, are flooded for two weeks and helped in their struggle for light and air, and, strengthened and invigorated by their native element, grow apace; water kills the weeds, but nourishes the rice. The water is now put down to the "slack-water" gauge, and if, as is generally the case, the plants are longer than the water is deep, the upper leaves float "in long, waving lines upon the surface"—a pretty, refreshing picture, once seen not soon forgotten. The water is gradually drawn off, and eight days after, when the field is dry, the ground is deeply hoed.

Volunteer rice, which is treated as a weed, often springs up with the regular crop. It is both hardy and prolific, and a great pest to the rice-planter. It can generally be removed by the hoes; then again it necessitates replowing and sowing, while sometimes the fields have to be thrown into dry crops for a year or two, or to remain flooded for that length of time. When harvested with the white, this red or volunteer rice greatly reduces its grade, and also renders it unfit for seed.

At hoeing-times a picturesque scene is presented, with say from fifty to one hundred men and women abreast, busily plying their hoes; the former in the utmost *négligé* of a laborer, and the latter with short, scant homespun dresses and leggins, *all* with broad-brimmed straw hats, or, in the case of the women, the head kerchiefs of the olden time. In the mouth of each is a stick, on the end of which is stuck, and smoking, a small piece of the punk taken from the heart of the oak. This smoke is for the purpose of driving away the myriads of "pesky" sand-flies that are more than enough to drive one wild, sometimes so thick that they have been known to cast a shadow. A young man, whiling away a summer holiday by a visit to the rice-field, essaying the same but to him untried expedient, and not understanding the manner of procedure, kept puffing away as if smoking a cigar, and soon had the punk in a bright blaze, so that he suffered the unpleasant consequences that await the inexperienced; there is something to be learned even from an ignorant rice-field darkey.

But in writing of rice and rice-fields I must not forget to give some prominence to the ravaging army of birds that feast upon the tender sprout and ripened grain, sometimes almost or quite

appropriating the crop. The rice-bird proper of Georgia and Carolina (*Emberiza oryzivora*), the reed-bird of the Middle States, and the bobolink of the North and West, is one and the same. It is about the size of a sparrow, and, while of grave and somber coloring during some months of the year, again decks itself in livelier plumage; and the quick, merry songs which enliven the grassy meadows during the breeding season, give place later to a "short, sharp chirrup." They are migratory, spending their winters mainly in the Western Isles. They come to the Southern States in early spring, leave, and return to the rice-fields in September and October. Continual war is waged against them by the rice-planter, and they are annihilated by the hundreds by the rusty muskets of the old darkey and the army of negro women; and one-garmented, short-skirted, dirt-besmeared urchins, who, by dint of "cracking" whips, and a continual switching at them, manage to at least mitigate the evil and give the persecuted rice a chance to grow. These little darkeys are sometimes negligent, and one of the old "drivers" used to say, "I gie um a licking, sah, fo dey go in fuh mek show ob dere bein' fateful."

Then, again, the rice-bird falls at the hands of the rapacious sportsman, who frequently by one shot puts an end to a *half-dozen dozen* little lives; and sometimes weary of gathering the plump little mouthfuls, so fat that they have been known to burst in falling, leaves many in the field, at the same time bearing home with him far more than "four-and-twenty" rice-birds to be "baked in a pie."

But to return to our more special subject. When the plant shows a joint the last hoeing is given, and the crop is "laid by" by the opening of the flood-gates, and turning on of the "joint water" or "harvest-flow," for the support of the plants, the field remaining under water until the grain is fully ripe, which may be two months. When matured, a few days before harvesting, the field is finally drained, and the ditches cleansed by the "succeeding tide."

HARVEST.—The rice is cut with sickles, the use of heavy machinery being impracticable in a rice-field. The crop is now left to dry; but the day after cutting, when free from dew, is tied in bundles, which are piled in ricks or upon platforms on the canals and rivers, so arranged as to shed the rain, until taken off by the barges to the thrashing-mills; these flats carry each the harvest of from five to seven acres.

AFTER HARVEST.—Now comes the gala day of the rice-field laborer, when the crop is being taken to the mill to be thrashed. The barges are numbered, say from one to ten, and great are the excitement and rivalry of the men in command, the same state of feeling pervading the whole force. With flags flying they bend

their full energies in the race from the fields to the mill, and long and wild are the exultant cries from the captain and crew of the barge that first moors at its destination and wins the prize offered by the planter. After this great exertion the careful master of the *ante-bellum* time generally dealt out to his slaves the expected grog, and required a bath and change of clothing.

THRASHING, ETC.—This is done by machinery: a thrasher much used was invented by Calvin Emmons, of New York. It separates the grain by tooth-beaters, which make from seven hundred and fifty to eight hundred revolutions per minute. The barge containing the bundles of rice passes under the mill, and its load is elevated by hooks to the floor above. When thrashed, if the crop is small, about five thousand bushels, it is put in sacks; but if large, say about forty thousand bushels, the paddy or rough rice is poured down a flume from the mill to the hold of the schooner in waiting, and is next taken to the cleaning-mill, which is frequently owned by the speculator that purchases it; and, when the grain is hulled, he in his turn sells it to the merchant.

By the *old* method the chaff was removed by pounding in hand-mortars hollowed out of pitch-pine blocks; it is now hulled by steam-power. When ready for market, the rice is put into barrels holding about six hundred pounds. The average of several analyses of rice gives—of albuminoids, 7·5; carbohydrates, 76·5; water, 14·6; ash, 6·5. Rice constitutes the food of almost one third of the human family. It is used in rice-meat and various aromatics, fermented and distilled into arrack, molded into models and busts, and is employed in paper-making, cement, and starch; the chaff, broken rice and dust, makes valuable food for cattle; the straw is sold for forage and bedding, and is also used in the manufacture of bonnets, while the Southern housewife can tell of the use of rice-flour in the making of delightful breads.

The total rice crop in 1870, according to the Federal census, was 73,635,021 pounds, a decided falling off from 215,313,497 pounds in 1850, and 187,167,032 in 1860. The yield for 1879 was better, being 110,131,372 pounds. Charleston, S. C., is the great rice market of the United States. The American grain is much preferred to the imported, and, as the demand is far greater than the supply, there is still ample room for the rice-planter.

It is observed, in Dr. G. M. Humphrey's book on Old Age, that the fertility of long-lived persons is above the normal, and in some continues to an advanced old age. The effect of the combination of conditions must be to give the stock of long-lived people an advantage in the race for existence, so that one would expect their number, in proportion to the rest of the population, rapidly to increase. This may help to account for the greater number of aged people, and the prolonged continuance of vigor among them.

SKETCH OF RENÉ DESCARTES.

PROF. HUXLEY, comparing the thoughts of men to the leaves, flowers, and fruit upon the branches of a few great stems bearing the names of the half-dozen men of strongest and clearest intellect, is of the opinion that "the thinker who more than any other stands in the relation of such a stem toward the philosophy and the science of the modern world is René Descartes. I mean," he adds, "that if you lay hold of any characteristic product of modern ways of thinking, either in the region of philosophy or in that of science, you find the spirit of that thought, if not its form, to have been present in the mind of the great Frenchman."

The London Spectator, reviewing Prof. Mahaffy's life of the philosopher, regards him as presenting the spectacle of a twofold life. "He was a man of society; he was a philosopher—the two were so completely distinct that they never came into collision. On the one side, he was inflexible, a pillar of intellect never deviating by a hair-breadth from rigid perpendicularity; on the other, he was all things to all men. For his intellect, the law was rejection of authority, assertion of absolute freedom; for the rest of him—for the man, distinguished from the philosopher—the law was courteous compliance all round."

RENÉ DESCARTES was born at La Haye, Touraine, France, March 31, 1596, and died in Stockholm, Sweden, February 11, 1650. He was the second son and third child of Joachim Descartes, who, having done some military service, had purchased a commission that gave him a place in the *demi-noblesse*. He inherited from his mother, who died at his birth, a feeble constitution, the marks of which he bore through life, and by reason of which the doctors predicted that he would die young; was baptized and brought up in the Roman Catholic faith; and betrayed from early infancy an insatiable curiosity and a disposition to inquire into the causes of things, which led his father to call him his philosopher. At eight years of age he was sent to the College of La Flêche, of the Jesuits, where he was remarked for his studious habits and the rapid progress he made in the knowledge of the ancients and in history. His delicate health seems to have contributed to his advance in scholarship, inclining him more to study than children of robust constitutions, and securing his exemption from morning duties, whereby he acquired the habit of meditating in bed. In that position a great part of the real work of his life was done. He accounted for his fondness for books by suggesting that the reading of good books was like a conversation with the brightest men

of past times, but superior to ordinary conversation because the speakers presented only their best thoughts.

Besides the text-books of the school, he was fond of reading such books as treated of curious and rare knowledge, and he had a high esteem for eloquence and poetry as gifts of genius rather than fruits of study. Those who can give clear and forcible expression to their thoughts, he said, though they spoke in Bas Breton and had never learned rhetoric, could always exercise the most persuasive power; and those who have the most pleasant fancies, and can express them most gracefully and with pertinent illustration, will not fail to be the best poets, though they have never studied the poetic art.

As the breadth of his knowledge enlarged, he grew more disposed to estimate the value of what he studied by its capacity of being made useful in life. He perceived the deficiencies of the logic and morals and of the physics and metaphysics that were taught in the college, and gained an increasing appreciation of the merits and beauty of the mathematical sciences. One of his first steps after leaving the college, he informs us in his Discourse on Method, was to discard his books, with all that he had learned that was uncertain, and to admit thenceforth only what seemed to have been demonstrated by reason and experiment. He therefore framed the method of examination and doubt, which, although he failed in very many instances to be true to it, has since become the great principle of positive science. He did not, however, he says, "imitate the skeptics, who doubt only for doubting's sake, and pretend to be always undecided; on the contrary, my whole intention was to arrive at certainty, and to dig away the drift and the sand until I reached the rock or the clay beneath."

After leaving the college, at the age of sixteen, he returned to his father, and in the next year went to Paris to participate in the social life of the capital and continue his studies. He renewed his school-day friendship with Marin Mersenne, now become Père Mersenne, of the Minim Friars, forming what proved to be a lasting alliance, and became associated with Claude Mydorge, one of the foremost mathematicians of France. Giving up the social side of his life, he withdrew for retirement and study to a secluded quarter. There is reason to believe that he made at this time some of his important geometrical studies, but he was not ready to publish them. A military career afforded at this age the most feasible means of getting the broadest views of life, and Descartes, in May, 1617, when twenty-one years of age, set out for the Netherlands and entered the service of Prince Maurice of Orange. Two years later he joined the forces of the Duke of Bavaria in the war between the house of Austria and the Protes-

tant princes. While in garrison at Breda, he saw one day a placard in Flemish to which the attention of a considerable crowd had been attracted. It was the statement of a mathematical problem, to which the author, after the fashion of the times, invited solutions. Not understanding the language in which it was written, Descartes asked one of the bystanders to translate it to him. This man was Beeckman, Principal of the College of Dort, himself a mathematician. Surprised to find a young soldier interested in such a matter, Beeckman explained the terms of the challenge with his most learned air. Descartes said at once that he would solve the problem, and brought the solution to Beeckman on the next day, having mastered it in less than an hour. The winter of 1619 was spent in quarters at Neuburg, on the Danube, to a large extent in study, and was, according to Dr. William Wallace, in the Encyclopædia Britannica, the critical period of Descartes's life. "Here, in his warm room, he indulged those meditations which afterward led to the Discourse on Method. It was here that, on the eve of St. Martin's day, he 'was filled with enthusiasm, and discovered the foundations of a marvelous science.' He retired to rest with anxious thoughts of his future career, which haunted him through the night in three dreams, that left a deep impression on his mind. 'Next day,' he continues, 'I began to understand the first principles of my marvelous discovery.'" In the next year he sought out the Rosicrucians, to obtain some knowledge of their supposed mystical wisdom, but without success. Descartes retired from military life upon the defeat and death of Count Bucquoy at the hands of Bethlen Gabor's revolted Hungarians in 1621.

During his career in the army, Descartes composed a Latin treatise on music, which he intrusted to Beeckman. It was surreptitiously copied, and was published without the knowledge of the author in 1618. It seems to have been considerably successful, and was reprinted several times and translated into English and French. But Beeckman's treachery cost him Descartes's friendship. Among other writings of this period, unpublished or lost, but mentioned in the catalogue prepared by Chanut on the order of Queen Christina of Sweden, are General Considerations on Science; a fragment on Algebra; Democritia, or Fugitive Thoughts; Experiments, or a Collection of Observations; and a collection of mathematical speculations entitled Parnassus. Descartes continued his travels in a private way, having in view, as he expressed his purpose, to look into the courts of princes, to become acquainted with men of different humors and different conditions, to inform himself concerning the natural products of different climates and the various civil usages and customs observed among different peoples; and to seek in the great book of the world knowl-

edge that could not be acquired elsewhere. From his observations he gained the great advantages of learning to believe nothing lightly, and not to hold obstinately to the things which example and habit had accustomed him to believe. He visited Holland, France, Italy, Switzerland, the Tyrol, Venice, and Rome. At Venice he witnessed the ceremony of the wedding of the Doge with the Adriatic. He made a pilgrimage to the shrine of Loretto.

Returning to France, Descartes entertained for a time the thought of purchasing a position as lieutenant-general of the province, at Châtellerault, but the legal chicanery connected with the office was not to his taste, and he gave up the scheme. He then took lodgings in Paris, and lived in the style of a modest gentleman at ease. He gathered a few friends around him, among whom were Mersenne and Mydorge, who were interested in the problems of the refraction of light; and together they experimented in the grinding of lenses. With others who came to witness the experiments, the house became a kind of academy, and too busy a resort to favor Descartes's studies. Meetings of literary men and students had become common in Paris, the more important ones being held with the Papal nuncio and Cardinal Richelieu. Descartes, urged by his friends, attended them frequently. He had, in his reflections on the choice of a position, become confirmed in the thought that he should not confine himself to any business, but should devote his life to the cultivation of the reason, and to advancement by every possible means in the knowledge of the truth according to the method which he had prescribed. At one of the meetings Cardinal de Bérulle was struck by a remark of Descartes's that the true art of memory was not to be gained by technical devices, but by a philosophical appreciation of things. He was thereby prompted to urge upon him a plan of life in almost exact accord with his conviction.

His associations in Paris, with their distractions not being favorable to the close attention which he sought to exercise to qualify himself for the execution of his purpose, Descartes determined to retire to some place where he could be alone and could pursue his studies untrammeled. He went to Holland, where he found variety and congenial retreats during the period from 1629 to 1649 in thirteen different places, and where he composed or revised most of his works. In the choice of these residences he seems to have been influenced, according to Mr. Wallace, by the two considerations of the neighborhood of a university or college, and the amenities of the situation. He appears to have also had a decidedly religious inclination. He found Franeker, the seat of a university, very agreeable, because it afforded him opportunity for attending mass, and gave him freedom in the religious exercises on which his attention was apparently most fixed during the

first nine months of his residence. He wrote from Amsterdam to Balzac, who had expostulated with him for having withdrawn himself from the world: "In this great city where I am, there being no one except myself who is not in trade, every one is so intent on his speculations that I might stay here all my life without being seen by any one. I walk out every day amid the confusion of a great people with as much freedom and peace as you could have in your garden walks, and I pay no more attention to the men who pass before my eyes than you would to the trees in your woods and the animals feeding there. Even the noise they make works no more interruption to my thoughts than would the rumbling of a brook." He resumed his studies in dioptrics. Observations on parhelia gave the origin to his treatise on Meteors. He entered with great ardor upon the study of medicine and anatomy, and visited the butchers' shops every day to witness the slaughter of animals, of which he brought parts home to his rooms to be dissected at his leisure. His correspondence with Père Mersenne abounded in mathematical problems which the two exchanged with each other. He studied astronomy and composed his Traité du Monde, in which he avowed the doctrine of the motion of the earth. On learning, however, of the condemnation of Galileo, he suppressed this book, saying, in a letter to Père Mersenne: "All the things I have explained, although I believe them to be supported by very certain and very evident demonstrations, I would not for the world maintain against the authority of the Church. . . . My desire to live in quiet and continue the retired life I have begun makes me more content to see myself delivered from the fear of having gained more fame than I wished for by my writing, than sorry for having lost the time and trouble that I have taken in composing it."

Descartes made three visits to France during his residence in Holland. The first was in 1644, to settle family affairs after the death of his father in 1640; the second was signalized by an award to him of a pension secured by Cardinal Mazarin of three thousand francs, in consideration of the advantages which his investigations had conferred upon mankind, and to aid him in continuing them; the third visit ended in disappointment, for the substantial results anticipated from it were nullified by the breaking out of the civil war of the Fronde. During the second of these visits he is said to have met Pascal, and suggested to him the thought of experimenting on the weight of the air. A visit was made to England for the investigation of magnetic phenomena, and in 1634 Descartes took an excursion into Denmark.

A controversy in 1638 with Fermat concerning that author's book on Maxima and Minima, and on tangents, engaged the friends of both parties, and resulted in a friendship between the

chiefs. Descartes had other discussions—with Petit on dioptrics, Morin on light, Beaugrand on geostatics, Roberval on the line described by a nail on the outside of a wheel in motion, and with Voët, Professor of Theology at Utrecht. The last controversy, which was brought on by Voët's criticisms of the indiscreet utterances of Descartes's disciple, Regius, resulted in Descartes being summoned before the magistrates of Utrecht on charges of irreligion and slander. He escaped the threatened prosecution by claiming the protection of the French ambassador and the Prince of Orange. An order forbidding all mention of the name of Cartesianism at the University of Leyden was likewise annulled by direction of the Prince of Orange.

Queen Christina of Sweden, interested in her way, although she was not yet twenty years old, in matters of literature and philosophy, having heard of the great fame of Descartes, conceived a desire to become acquainted with him. He was drawn into a correspondence with her through Chanut, the French ambassador to Sweden, to whom he sent a dissertation on Love, which was intended for her. He followed this with an essay on the Chief Good, addressed directly to the queen. Finally, she invited Descartes to go to Sweden and give her lessons in philosophy. Descartes acceded to the request after considerable hesitation. He reached Stockholm in October, 1649. The queen was very exacting in her demands on the philosopher, and required, among other things, that he attend upon her every morning at five o'clock. The hardship of this duty, which did violence to his life-long habit of lingering in bed, with other incidents of his life at the Swedish capital, combined with the rigor of the winter climate, were too much for Descartes, and entailed upon him a pneumonia, from which he died.

The written works of Descartes were collected and published in Latin in 1670–'83. A selection from them was published in Paris in 1843, and a collection of his moral and philosophical works in 1855.

The earliest work was the Discourse on the Method of Reasoning Well and Seeking the Truth in Science, which, besides the exposition of general principles, according to the description in the title, contains treatises on Dioptrics, Meteors, and Geometry, the general scope of which is indicated by their titles. The central propositions of the whole Discourse, according to Prof. Huxley, are: "There is a path that leads to truth so surely that any one who follows it must needs reach the goal, whether his capacity be great or small. And there is one guiding rule by which a man may always find this path and keep himself from straying when he has found it. This golden rule is, Give unqualified assent to no proposition but those the truth of which is so clear and dis-

tinct that they can not be doubted." Descartes attached less importance to the geometrical and mathematical methods of which he was the inventor than to his moral and metaphysical speculations. But, while the latter have been sifted and riddled in discussion, and have suffered under the revolutions of thought, the mathematical principles he established and the methods he introduced remain. In geometry he gave demonstrations of general principles, under which solutions adapted to one problem could be applied to all like it. In algebra, for the old clumsy notation and nomenclature, always suggesting material relations, he substituted the beautiful, convenient system, purely abstract, by the aid of which that branch of the science has marched to almost universal application and perfection. And in the application of algebra to geometry, he introduced the method of abscissas and ordinates, by means of which any curve and any condition of form can be computed by a process as beautiful as it is direct.

The Meditations on the First Philosophy, which appeared in manuscript in 1640, consists of six parts, in the first of which the author expounds his philosophy of doubt; in the second, he reaches the certainty of his own being, through the use of his famous maxim, *cogito, ergo sum* (I think, therefore I am); in the third, he deduces an argument to prove the existence of God from the idea of an infinite and sovereignly perfect being; in the fourth, he draws a distinction between speculative reasoning, for which the light of nature is sufficient, and doctrines of faith and the conduct of life, which rest on another foundation; in the fifth, he explains the corporeal nature, and brings forward another argument for the existence of God; and in the sixth he treats of the distinctions between intellect and imagination, the difference yet intimate connection of soul and body, errors of the senses and the means of avoiding them, and the reasons upon which we can conclude concerning the existence of material things, which he, however, regarded as inferior to the evidence on which we predicate the existence of God and the soul. The book in this form was submitted to the criticisms of a number of distinguished students, whose objections were printed and bound with the main treatise when it was published in 1641, and with them the replies of the author, considerably swelling the bulk of the volume.

The Principles of Philosophy, 1644, contained an exposition of the principles of knowledge as developed in the Meditations; an explanation of the primary laws of nature, the properties of matter, space, motion, etc.; the system of the world, the sky, and celestial bodies; and a treatise on the Earth. The statement of the three laws of nature, the seven secondary laws of impact (which are pronounced by later science to a large extent incorrect), and the famous theory of Vortices, by which Descartes at-

tempted to account for the structure of the universe, are contained in this work. The first of the three laws affirms that every body, so far as it is unaffected by extraneous causes, always perseveres in the same state of motion or rest; and the second that simple or elementary motion is always in a straight line. "These doctrines of inertia, and of the composite character of curvilinear motion," says Mr. Wallace, "were scarcely apprehended even by Kepler or Galileo; but they follow naturally from the geometrical analysis of Descartes." He taught that extended matter has no limits to its extent, though the power of God has divided it by lines discriminating its parts in endless ways. He denied the possibility of a vacuum, and the existence of atoms or ultimate particles, and regarded matter as uniform in character throughout the universe—all of which views are consistent with what may be logically deduced from the results of the latest investigations. In the universe packed with matter, no particle can move unless all the others move too. Hence we have universal motion, taking the form of "a host of more or less circular movements, and of vortices or whirlpools of material particles, varying in size and velocity." These vortices, which were supposed to give rise to three kinds of matter and to the phenomena of radiating light, were made to account for the existence and motions of all the stars and systems, the sun and planets, and the earth. Descartes applied his vorticellar theory not only to all the phenomena of physics, but also to those of organic life, including that in animals and man; whence he ventured to show that man and the animals are really machines, with the single difference that man has a rational soul, while the animals have not. In the Treatise on Man and the Formation of the Fœtus, which was published after his death, Descartes expounded the doctrine of animal spirits. Other works are the Treatise on the Passions of the Soul, which was translated into French for Madame Elizabeth, Princess Palatine; and the Rules for the Direction of the Mind, a posthumous work. Descartes was never married, but he is believed to have had a natural daughter, Francine, who died when she was five years old. He is described as having been "a little man, with a large head, projecting brow, prominent nose, and eyes wide apart, with hair coming down almost to his eyebrows," and feeble voice, and as usually dressed in black.

On his death, Queen Christina wanted him buried with the kings of Sweden; but Chanut, who is supposed to have carried out his wishes, had his body modestly interred in the cemetery of the Orphans' Hospital, where Catholic foreigners were usually buried. Thence his remains were a few years afterward transferred to France, where, after several changes, they were finally deposited, in 1819, in the Church of Saint Germain des Prés.

EDITOR'S TABLE.

SIR WILLIAM DAWSON ON EVOLUTION.

SIR WILLIAM DAWSON, the well-known Canadian geologist, has brought out, under the auspices of the Religious Tract Society of London, England, a work entitled Modern Ideas of Evolution as related to Revelation and Science. The title of the book, we must say at the outset, seems to us a little peculiar. Any idea of evolution (as the term is now understood) must, if considered at all, be considered in relation to science; but how to consider it in relation to revelation is not, to our mind, easy to understand. How are ideas of evolution to be brought into direct relation with revelation as a substantive fact? If revelation is a substantive, self-evident fact, then there is no use in bringing any ideas of evolution into comparison with it. The Arab leader who burned the library at Alexandria did not want to compare any of the books contained therein with the Koran, but summarily said: "They either agree with the Koran or disagree with it. If they agree with it, they are superfluous; if they disagree with it, they are noxious: in either case burn them." In like manner, no one who reads the laws of nature in the blaze of an all-sufficient revelation will want any other light. Had Sir William spoken in the title of his book of bringing "ideas of evolution" into relation with "*ideas* of revelation," the proposition would have appeared a more hopeful one, and would have contained a certain suggestion of fair play; but to bring mere "ideas" on the one side into direct contact with the most absolute and commanding reality on the other, seems—well, not quite the right thing to do. Give the "ideas of evolution" a chance; let there be something to "umpire."

Sir William Dawson has written this book for a select circle of readers—a wide one possibly, but select nevertheless—readers who appreciate such a description of Darwin as the following: "Darwin, as he sits in marble on the staircase of the British Museum, represents a noble figure, made in the image of God, and capable of grasping mentally the heaven above as well as the earth beneath. As he appears in his recent biography, we see the same man paralyzed by a spiritual atrophy, blinded and shut up in prison and chained to the mill of a materialistic philosophy where, like a captive Samson, he is doomed to grind all that is fair and beautiful in nature into a dry and formless dust." It is needless to say that a reader at all accustomed to scientific method would wish to know exactly what is meant by ability to "grasp mentally the heaven above as well as the earth beneath." Darwin, it seems to be admitted, grasped the earth beneath: in order to grasp the heaven above—interpreting the words in a natural sense—he would have had to be an astronomer in addition to being a great biologist and naturalist. The writer, however, does not use the words in their natural sense: by the "heaven above" he means some supernatural order of facts; but could he, as a scientific man, tell us of any one who to his positive knowledge had "grasped the heaven above" in that sense? When Darwin grasped the earth beneath he could tell us what he grasped, and the world is vastly the richer to-day for the positive knowledge imparted by him in regard to terrestrial facts. But could Sir William Dawson himself enrich the world by imparting what he has grasped of "the heaven above"? What does he know about it that he can communicate in distinct speech? If he has any such information, it would vastly surpass in interest anything he can tell us about

the *Eozoön canadense;* but we venture to say that, in spite of his slur upon Darwin for not having grasped this kind of knowledge, he does not himself possess one particle or scintilla of it that he could teach as fact to any human being.

Then what are we to say about the accusation against Darwin of grinding "all that is fair and beautiful in nature into a dry and formless dust"? All that we can say of it is that it is false, and, as coming from a man of recognized scientific position, deplorable. Nature to Darwin was full of interest to the last; and few men have done more than he to awaken an interest in and love of nature in others. We have only to read his correspondence with the foremost naturalists of the time to see what a center of interest he was to them, and what a living thing the study of nature under his guidance, or upon lines indicated by him, had become. The fact is that organic nature was never so interesting a subject of study as it is to-day; and few will deny that this is due, in large measure, to the influence of Darwin—the man who is now accused of turning "all that is fair and beautiful in nature into a dry and formless dust." When people who claim to "grasp the heaven above" indulge in such unfounded and uncharitable remarks about their intellectual superiors, one is apt to wonder whether their prehensile powers have really been exercised to the best advantage.

That Sir William Dawson did not write this book for a scientific public is evident by many signs. When he speaks of standing near to the "treacherous margin" of the evolution philosophy and rescuing a few grains of truth, he writes—there is but one expression for it—utter nonsense. Imagine for one moment a scientist, a philosopher, stealing gingerly to the edge of a system of philosophy and putting out a timorous hand to clutch a grain of truth, whirling, as it were, in a vortex! Imagine the scientist, the philosopher, dreading to be sucked in, and quickly retreating with his rescued grain to a safer footing! Again, when he tells us, in effect, that the controversy between Huxley and Harrison supplies "an evidence of the need of a divine revelation," we are persuaded that such an utterance could only have been intended for very shallow minds. More need for a revelation, we should say, if Harrison and Huxley agreed, for how should we know that they were not both in error? When they disagree, there is at least a probability that the errors of the one will more or less cancel those of the other, and that some residuum of truth will be left behind. It is hard to see how truth could be established except by conflict, or how minds could develop except through contact and collision with other minds. Think what a lot of simpletons we should become if, as often as a difference of opinion arose, instead of being left to weigh the arguments on either side, we were at once to hear an authoritative voice deciding the whole question! It will greatly please most of the readers of this book to be told that Darwin took a very "unscientific" position in "enthroning chance or accident or necessity as Lord and Creator"; and it will not trouble them in the least to remember—if they do remember—that, on the immediately preceding page, it was stated that "Darwin's natural turn of mind and his scientific training were not of such a character as to lead him to seek for ultimate causes; he was content with a modal evolution (i. e., with evolution considered and treated as a method); he took matter and force as he found them." The two statements are in obvious conflict, and the one on the earlier page is the correct one. Darwin did not enthrone chance; he took matter and force as he found them; and to us his position appears entirely scientific. Herbert Spencer, by a long course of reasoning, arrives at the conclusion that the First Cause is inscrutable. Darwin assumed as much without going through

any troublesome logical process. Nobody in this world, except perhaps some superstitious gambler, ever "enthroned" chance, and even he is imposed upon by words.

One is compelled to ask the question whether the author is as inapt at philosophical reasoning as his book indicates, or whether he has simply put aside his philosophy in order that he may not affright the babes to whom it is his evident purpose to minister. He tells us that it is "a striking inversion of ordinary probabilities" to suppose that the environment can influence the development of organisms; that inanimate nature can "rule, determine, and elevate that which lives and wills." Does not the law of gravitation rule and determine in a very great degree nearly all the phenomena of human life? Does not diet determine the quality of the blood, and the quality or condition of the blood influence thought? Is not civilization largely a matter of climate and general physical conditions? The world might have been much better than it is, we are told, if it had pleased God "to produce a superior race of beings." This is Sir William Dawson's dictum: we know nothing about such matters; all we know is that no race superior to man has been produced; and we are disposed to conclude that man, as he is and has been, stands in definite relation to the condition of things on this planet. That a being of infinite power, who might have done better, should have been content with doing worse, is an idea which we prefer to leave to the contemplation of the author. Another example of what may well be called baby philosophy is where, speaking of the idea that there may be among the organs of the body a certain struggle for existence and pre-eminence, our author declares it to be "revolting to common sense and hideous to right feeling." What has a student of science to do with any idea put forward as scientific except to bring it, if possible, to the test of facts? To us it is no more "revolting" or "hideous" that there should be a struggle for existence going on between the different cells of our body than that the movement of the earth in its orbit should be the resultant of two antagonistic forces, or that our social system should be the result of the competing activities of its individual members. "On this view," says our author, "the mechanism of an animal ceases even to be a machine, and becomes a mere mass of conflicting parts thrown together at random, and depending for its continued existence on a chance balance of external forces." Does the solar system cease to be a machine because it is controlled by the rival laws of gravitation and inertia—because the planets are acted upon at once by a centripetal and centrifugal force? Does the social organism cease to be a machine because its balance is maintained by the self-seeking and mutually-limiting activities of its members? To talk of "a *chance* balance of external forces" is irrelevant and meaningless. What we know is that there *is* a balance, that it has endured long enough for the development of an infinite number of organic forms in adaptation to it, and that there is no apparent reason why it should not continue. That is all any one who is determined not to transcend the facts can say. We have not space to examine the more detailed reasonings of the author of this book; but its general philosophic tone may be correctly judged from what precedes. It is not a book that will enhance the reputation of the Canadian scientist.

THE AMERICAN ASSOCIATION.

THE meeting of the American Association just held at Indianapolis may be regarded as one of the best of recent years. The attendance was up to a good average in numbers and embraced a good many distinguished names, both among the older and newer generations

of workers. Ample accommodations were provided in the new State-House, where all the meetings could be held under a single roof. The citizens of Indianapolis, who as a community are busy in turning the achieved results of science to profit, were enthusiastic in welcome and kindnesses.

The more noteworthy papers, including the official addresses, well befitted the name of the body, and were true to its declared purposes of promoting intercourse between students and encouraging more active and more systematic research; and a considerable proportion of them were at the same time happily adapted to the average intelligence of a public audience and in the direction of popular questionings.

Retiring President Mendenhall treated in his address of the relations that exist and should exist between scientific students and the public. While he sought to determine how far men of science are responsible for any lack of cordiality that may exist, he demonstrated to business men, by means of a very happy illustration, that they are enjoying direct benefits from the results of abstract research to a far greater extent than they realize or imagine. His remarks, on both sides of this subject, deserve particular attention. Vice-President Branner, considering the relations of State and National Geological Surveys, endeavored to sketch a plan of combined action, under which the party of either side could do the work proper for it without encroaching upon the field of the other, and room be left for individual research. Vice-President Dodge, in the Economic and Statistical Section, set forth in a pleasant light the advantages enjoyed by the producing classes in the United States in relation to the standard of living. In relating the present condition of knowledge respecting the variable stars, Prof. Chandler had a subject that involves research of the highest order, of which at the same time every one desires to be informed. In a large number of the sectional papers, too, the sober dignity of the scientific method was combined with adaptation to the tastes of hearers of a practical turn.

Societies outside of the sections and complementary to them continue to grow around the Association. The meetings of the Society for the Promotion of Agriculture were lively and practical; those of the Geological Society were more technical in tone. The Entomological Club insisted on the extension and enlargement of the study of insects. An Ornithological Society was formed, and went at once to talking about birds. The Botanical Club held its eighth annual meeting. Prof. Britton, under instructions from the Toronto meeting, gave an account of the present state of systematic botany in North America. A National Chemical Society was projected.

The fact that this was the fiftieth meeting of the Association does not seem to have received special attention further than a mention in Prof. Mendenhall's address. The fact that the Association has maintained its vigor and has prospered during half a century is evidence that it has had a place of usefulness and has filled it. The question now arises whether, if it would meet the demands of the future as successfully as it has met those of the past, it will not have to adapt itself anew to the changed conditions of science and the country and to the present popular demand for scientific knowledge, which are very different now from what they were when it began.

The doors of the Association were thrown open to members of foreign societies, who will be admitted hereafter, with full privileges, without fees; and provision was made for inviting to the next meeting representations of the scientific societies of Mexico and Central and South America. The following officers were chosen for the ensuing year:

President.—Albert B. Prescott, Ann Arbor, Mich.

Vice-Presidents.—A, Mathematics and Astronomy—E. W. Hyde, Cincinnati, O. B, Physics—F. E. Nipher, St. Louis. C, Chemistry—R. C. Kedzie, Agricultural College, Michigan. D, Mechanical Science and Engineering—Thomas Grey, Terre Haute. E, Geology and Geography—J. J. Stevenson, New York. F, Biology—J. M. Coulter, Crawfordsville, Ind. H, Anthropology—Joseph Jastrow, Madison, Wis. I, Economic Science and Statistics—Edmund J. James, Philadelphia.

Permanent Secretary.—F. W. Putnam, Cambridge, Mass.

General Secretary.—Harvey W. Wiley, Washington, D. C.

Secretary of the Council.—A. W. Butler, Brookville, Ind.

Auditors.—Henry Wheatland, Salem, Mass.; Thomas Meehan, Germantown, Pa.

Treasurer.—William Lilly, Mauch Chunk, Pa.

The meeting for 1891 will be held in Washington, D. C.

LITERARY NOTICES.

THE EVOLUTION OF SEX. By PATRICK GEDDES and J. ARTHUR THOMSON. The Contemporary Science Series. New York: Scribner & Welford. Pp. 322. Price, $1.25.

THE purpose of the Contemporary Science Series is to bring within general reach of the English-speaking public the best that is known in all departments of modern scientific research. Frank investigations and clear presentations are promised, in particular, of all the questions of modern life—the various social and politico-economical problems of to-day, the most recent researches in the knowledge of man, the past and present experiences of the race, and the nature of its environment. The first book issued in this series covers a field in which lie some of the most difficult as well as most generally interesting of biological questions. The subject is, therefore, an attractive one both to trained biologists and to persons without special training, and the wants of both these classes of readers have had consideration in the mode of treating the subject which the authors have pursued. They undertake to give an outline of the various kinds of reproductive processes that occur in the animal kingdom, and to point out an interpretation of these processes in the elemental facts of biology. They have decided opinions on the important biological questions now in dispute, which are not always the ones generally accepted, and especially as regards the factors of organic evolution. Hence they are continually joining issue with this or that evolutionist or physiologist, agreeing only in part with any one. Darwin's theory of sexual selection comes up for criticism at the very outset, and both this and Wallace's views on natural selection are rated as accounting for the acquirement of secondary sexual characters only in part. The authors offer, as a broader and more fundamental explanation of the origin of sexual differences, that katabolic, or destructive, changes in living matter prevail in the male, while anabolic, or constructive, action characterizes the female. This idea as to the essential difference between the sexes is the key to the whole theory of sex relations held by the authors. Thus, in regard to what determines sex in the embryo, concerning which over five hundred theories have been set forth, they say that anabolic, or favorable, conditions of the environment tend to cause the production of females, while katabolic, or severe, surroundings favor the appearance of males. A considerable division of the volume is devoted to a description of the organs, tissues, and cells concerned in reproduction, in the course of which an account is given of the phenomena of hermaphroditism. In concluding this section the theory of sex already alluded to is fully set forth. The various modes of reproduction which obtain in the animal kingdom are then described, including parthenogenesis, which leads to a discussion of the alternation of one-sexed and two-sexed generations. The theory of reproduction which the authors advance is that there is a continual see-saw between anabolism and katabolism, nutrition and reproduction. Growth of cell and of organism alike has a limit which, as stated by Spencer, depends on the tendency of increase of mass to outrun increase of surface. When anabolism threatens to pass this limit, katabolism acts and restores the preponderance of surface. Reproduction is continually going on in organic

nature, because on the whole the katabolic conditions of the environment preponderate over the anabolic. In conclusion, certain psychological and sociological aspects of sex relations are discussed, namely, the occurrence of the love of mates and of offspring among animals, the intellectual and emotional differences between the sexes, and the various proposals for checking increase of population. The authors express strong aversion, based on biological grounds, to the recent attempts of some women to mold their sex into the fashion of men. They hold that the difference between the mental capabilities of women and men is highly beneficial to the race, and is hence to be fostered and not obliterated. Each chapter of the work is followed by a summary of its main points, and a list of books bearing upon the special topic under treatment. The authors have discussed the recently published views of Prof. Weisman on Heredity, and have taken account also of Wallace's latest criticisms on Darwinism. They express regret that limits of space have made it impossible to give the botanical side of their subject its proportionate share of attention, but they have inserted illustrations of the essential facts, which they deem sufficient to show the parallelism of the reproductive processes throughout nature. A defect of the book is in its language, which is frequently so involved as to be obscure, and is still oftener awkward. The volume is illustrated and has an index.

THE METALLURGY OF STEEL. By HENRY MARION HOWE. Vol. I. New York: The Scientific Publishing Company. Pp. 380, quarto. Price, $10.

In this work metallurgists are provided with an account of the most important of metallurgical industries on a scale which is seldom ventured upon. Its purpose is to describe the present practice of steel-making in America without attempting to give the history of the industry. Hence the author says: "In describing old experiments and abandoned processes, I have not aimed to give matter of historic interest, but rather that which might be useful, whether in deterring others from repeating unnecessary or hopeless experiments, or in guiding them should processes once unsuccessful become commercially possible through changed conditions." Most of the first half of this volume is devoted to the characters of different steels, produced by admixtures of carbon, silicon, manganese, and other metallic and non-metallic elements. In considering the effect of carbon on iron, the author presents both the chemical and the microscopical evidence which goes to show that there are two conditions of combination of carbon with iron. In one of the early chapters the processes of hardening, tempering, and annealing are described, and the changes produced in the metal by these operations are explained. The absorption of gases by iron and their escape from the metal, and the various means taken to prevent the consequent forming of blow-holes and pipes, form a division of the subject that receives full discussion. The author considers next the varieties of stucture shown by the microscope, and the changes of crystallization, etc., produced by various treatments of the metal. The operations included under cold working and hot working are then described, after which the making of steel is taken up. A great many varieties of the direct process, several charcoal-hearth processes, and the crucible process are described and their results are compared. The closing chapter is a description of the apparatus for the Bessemer process, including a variety of modifications. The material of this volume has been published in supplements to The Engineering and Mining Journal within the past two years, during which time new results have been attained in some departments of the subject. Some of these—namely, on manganese steel and other special steels, on anti-rust coatings, and on lead-quenching—are added in appendixes. In stating the cost of metallurgical processes, the author has generally given the quantities of material and the amount of labor needed for a given work rather than the expense in dollars and cents, for the reasons that the former fluctuate less than the latter, and more managers are willing to tell what quantities of materials they use than what is their exact cost of production. He has inserted a great many references to original authorities, for the purpose of showing that his statements have a solid foundation, or so that the reader may examine any special topic more in detail. In re-

gard to his use of material already published the author says: "Such a work as this can not, of course, be carried out without much compilation; but by far the greater part of the labor has been expended in the original work of discussing the data thus compiled, and in acquiring wholly new data, whether by experimental research or in prolonged examination of the processes described. For instance, there are about two hundred tables in this volume; of these, all but about twenty (and most of these twenty are very small) are either wholly original or consist mainly or wholly, not of matter published by others, but of numbers calculated therefrom." As to revealing trade secrets, his rule has been to give all the information about present practice that seems useful and that he has permission to give, while trying to conceal the identity of the establishment at which it exists. This volume being numbered one, implies another or more to follow it, but no announcement of succeeding volumes is made in the one now issued.

REPORT UPON UNITED STATES GEOGRAPHICAL SURVEYS WEST OF THE ONE HUNDREDTH MERIDIAN, in charge of Captain GEORGE M. WHEELER. Vol. I, Geographical Report. Washington. Pp. 780, quarto, with Plates and Maps.

THIS report was practically completed in June, 1879, but the officer in charge was prevented, by a press of other duties and by subsequent prolonged illness, from presenting it for publication until 1887. The series of expeditions covered by the report was made under the direction of the Chief of Engineers, United States Army, in 1869, and in successive years from 1871 to 1879, inclusive. On the organization of the Geological Survey in 1879, surveys by the War Department for military and industrial purposes were discontinued. The results obtained in these expeditions were published in eight quarto volumes, each devoted to a special topic, as astronomy, geology, etc. The present volume gives a brief account of the expedition of each year, with a summary of results. In 1871 a party explored the Grand Cañon of the Colorado River in boats, from Camp Mohave to Diamond Creek. An itinerary of this trip is given, to which is prefixed a sketch of earlier explorations along this river. Some account is given of the population, industries, irrigation, and land classification in the regions explored, which include parts of New Mexico, Arizona, California, Nevada, Utah, Colorado, Idaho, and Oregon. In several appendixes are given descriptions of the atlas sheets issued as a part of these reports, an account of the methods of survey employed, notes on the survey and disposal of the public lands of the United States (with map), and considerations on the government land and marine surveys of foreign nations. The last appendix is a memoir on discoveries and explorations on the Pacific Coast of North America and in the interior west of the Mississippi from 1500 to 1880. In the first part of the memoir the explorations between 1500 and 1800 are mentioned, and eleven curious old maps are reproduced which show the very imperfect knowledge of America that existed during much of this period. This is followed by an epitome of the memoir by Lieutenant G. K. Warren, made in 1858, on the explorations west of the Mississippi from 1800 to 1857, and by a sketch of the explorations and surveys from 1857 to 1880. The volume contains three folded maps and thirty-eight plates, the latter including the eleven old maps already mentioned, and representing also typical localities, contours, Indian costumes, etc., in the country examined.

PHYSIOGNOMY AND EXPRESSION. By Prof. PAOLO MANTEGAZZA. The Contemporary Science Series. New York: Scribner & Welford. Pp. 327. Price, $1.25.

IN this treatise the author takes up the study of expression at the point where Darwin left it, "and modestly claims to have gone a step further." There is a great deal of chaff in the literature of the subject; and the author, who is one of its most accomplished students, has accordingly had the task set before him of separating once for all positive observations from the number of bad guesses and ingenious conjectures which have hitherto encumbered the study. His wish, he says, has been "to render to science what is due to science, and to imagination what is due to imagination." Besides new facts, the reader is invited to find in his work facts already known, but inter-

preted by new theories. A historical sketch of past studies and treatises on expression is given. Of authors of the old school, Lavater is found to have come the nearest to being scientific. The real science begins with Camper, from whom the famous facial angle took its name. But the great anatomists and physicists who preceded Darwin only touched one side of the problem—expression in its relation to art and the æsthetic. Darwin traced the general laws which govern expression in the whole animal kingdom; and in his book, published only in 1872, expression, in so far as it is a special branch of comparative biology, asserted itself as a new science. In the science of the present day we have, on one side, a study of the human countenance, which is associated with anatomy and anthropology, and, for its application, with all the plastic sciences; and, on the other side, a study of expression, and of expression in relation to psychology, to comparative ethnology, "the applications of which interest in turn painter, sculptor, and actor." The present book proposes "modestly to restore to anthropology and to psychology what belongs to either, and to make known the positive documents which we possess to-day on the human countenance and on expression." Two diverse and important functions are accorded to physical expression—it may replace or complete language, and it may defend the nerve-centers and other parts of the body against dangers of different kinds. Including all living beings in a general view, we may, according to the author, say that the expression of emotion augments in intensity and variety as the animal rises to a higher scale and becomes more sociable. These two maxims concerning the office and the development of expression, which we have selected from the observations in the chapter on the Language of Expression, indicate the importance and interest of the study. The first part of the treatise is devoted to the human face, its several features, and its comparative morphology; the second part to the expression of the emotions, in which, besides what are usually understood under that term, are included the minor emotions or feelings, the expression of thought, the general expressions of repose and action, disquietude, etc., and racial and professional expression, with additional chapters on the moderators and disturbers of expression, criteria for the determination of the strength of an emotion by the degree of expression, for judging the moral worth of a physiognomy and the intellectual value of a face, and on the physiognomy of gestures and the expression of clothes. While the scientific is predominant in the method of the book, a kind of literary discursiveness is frequently indulged in which supplies pleasant reading supplementary to the solid principles of the bulk of the text.

GEOLOGICAL SURVEY OF NEW JERSEY. ANNUAL REPORT OF THE STATE GEOLOGIST FOR 1889. Pp. 112.—FINAL REPORT OF THE STATE GEOLOGIST. Vol. II, Part I. Pp. 642. New Brunswick: Irving S. Upson, Assistant in charge of the Office.

THE survey was continued through 1889 on the lines planned by Dr. Cook before his death, which occurred on the 22d of September. A leading object in the work has been, as heretofore, to develop and make public the natural products and resources of the State. The present volume bears evidence, continuing and additional to that given in previous volumes, of the success with which this object has been met. The geodetic survey was continued during the year, after having been suspended in 1888, southerly and westerly from the line—Hammerton-Newfield—which was reached in 1887. In a section on the archæan rocks, Mr. Frank L. Nason gives a historical review of what has been done in the Archæan Highlands since 1836; and continues with a report of the field-work of the year, descriptions of the type rocks of the region and their distribution, studies of the economic value of rocks, and special notes on the zircon and molybdenite found there. The section on Water-Supply and Artesian Wells, by Mr. C. C. Vermeule, includes accounts of the measures which have been taken to secure a water-supply to several cities and towns, and notes of the observations made in boring nearly thirty artesian wells in different parts of the State. The borings of a well at Atlantic City, to a depth of about 1,400 feet, show that the Quaternary gravels and sands are over 200 feet thick, and the strata under them to 1,225 feet are Miocene, while below that depth no fossil is yet found distinctive

of the Eocene. The second volume of the Final Report is devoted to the mineralogy, botany, and zoölogy of the State; the first part comprising the mineralogy and botany. The minerals—for which, by reason of the great number of species and varieties, their rare chemical combinations, and their wonderful crystalline development, the localities of New Jersey are famous—are catalogued by Mr. Frederick A. Canfield, with the aid of the best collections. The Flora of the State is divided by Dr. N. L. Britton, who furnishes the catalogue, into a northern and a southern, the division between which is approximately indicated by the glacial moraine. A minor division includes the marine and coast group of plants, species, and varieties especially characteristic of the seabeaches and salt or brackish marshes and meadows; and a fourth group is made of species of especial western distribution, which, however, have no special significance in the consideration of the origin of the flora. In all, 5,641 species and varieties of plants are catalogued.

WHEELBARROW: Articles and Discussions on the Labor Question. Chicago: The Open Court Publishing Company. Pp. 303. Price, $1.

"WHEELBARROW" appears to be both the title of this book and the pen-name of the author. The volume is made up of articles contributed to The Open Court over this signature, containing also two by Lyman J. Gage, written in controversy with "Wheelbarrow" over The Ethics of the Board of Trade. The articles are intended to present various topics of the labor question from the standpoint of a common laborer, which was the author's position in early life. His autobiography prefixed to the volume informs us, however, that he rose from the occupation of wheeling gravel on railways through the grades of country school-teacher and brickyard laborer to that of lawyer. He served in the army during the war with Mexico and the civil war, and attained the rank of brigadier-general, and we understand that he is General M. M. Trumbull, of Chicago. His portrait is inserted as a frontispiece to the book. The tone of the "Wheelbarrow" essays is against the revolutionary schemes of some who call themselves workingmen, and in favor of a manly independence and a generous fraternity on the part of laborers, in their relations with their employers and with each other. On the money question he argues for a hundred cents' worth of silver in the silver dollar; he opposes Henry George's single-tax idea; and he charges the produce brokers with "making bread dear." The volume contains also three essays on The Poets of Liberty and Labor, namely, Gerald Massey, Robert Burns, and Thomas Hood. The articles are written in simple and picturesque language, and the views they contain are enforced by many anecdotes and fables.

EVOLUTION AND DISEASE. By J. BLAND SUTTON. The Contemporary Science Series. New York: Scribner & Welford. Pp. 285. Price, $1.25.

THE author's purpose in writing this book has been to indicate that there is a natural history of disease as well as of plants and animals. It is difficult to define disease when our remarks are restricted to the human family; and it becomes obviously more difficult when we attempt it, as the author has done, on a broad zoölogical basis. It necessarily follows, he assumes, from the relations between man and the higher animals, "that there should be a similarity in the structural alterations induced by diseased conditions in all kinds of animals, allowing, of course, for the differences in environment. This we know to be the case, and it is clear that as there has been a gradual evolution of complex from simple organisms, it necessarily follows that the principles of evolution ought to apply to diseased conditions if they hold good for the normal or healthy states of organisms; in plain words, there has been an evolution of disease *pari passu* with evolution of animal forms." In view of the talk of physiological types of diseased tissues, the author's earlier efforts were directed to searching among animals for the purpose of detecting in them the occurrence of tissues which in man are found only under abnormal conditions. The hypothesis proved to be true in only a limited sense; but, "at the same time, the truth of an opinion held by nearly all thoughtful physicians—that disease may in many instances be regarded as exaggerated function—was forci-

bly illustrated, and I quickly saw that the manifestations of disease were regulated by the same laws which govern physiological processes in general, and that many conditions regarded as pathological in one animal are natural in another." This view is enforced in the successive chapters of the book, in which—according to the author's plan of treatment as summarized by himself—the effects of increased use and disuse of parts are considered in connection with the gradual change in function of organs, and the part played by transmission of the effects of increased use and disuse in producing vestigial structures in complex organisms. The tendency of vestigial structures to become diseased, or to give rise to conditions disadvantageous to the individual, is dealt with. The transmission of acquired characters and malformations is discussed. Causes of disease arising without the organism, and the relations they bear to inflammation and fever, are given a chapter. Tumors are considered in connection with general morbid processes, and the scanty knowledge we possess of the zoölogical distribution of disease is summarized. The illustrations of the principles have been selected, whenever it was practicable, from animals other than man, for the author believes that man has been studied too exclusively.

LONGMANS' SCHOOL GEOGRAPHY FOR NORTH AMERICA. By GEORGE G. CHISHOLM and C. H. LEETE. New York: Longmans, Green & Co. Pp. 384. Price, $1.25.

THE first feature of this work to be noticed is its departure from the familiar thin quarto form in which geographies that combine maps and text are made. This volume contains only text and illustrations, and is intended to accompany an atlas. An examination of it will not proceed far before showing that it differs from the ordinary geography in something more important than form. The book aims to set before the pupil those facts of geography that are most worth his knowing, and that are most effective as discipline. Hence all countries are not described in conformity with a rigid outline, but the characteristic features of each are given especial prominence. The authors have sought to make the study of geography something better than a memorizing process by bringing out the relations of cause and effect. To aid in this latter purpose, the general laws of physical geography are stated in an introduction, and to this chapter are referred the facts that especially illustrate the laws. Cause and effect are particularly developed in the paragraphs on towns, where it has been sought to show why and on what basis a town exists in any particular place. In the description of the natural features of a region, little regard is paid to the artificial boundaries of political divisions and subdivisions. Thus, in the treatment of North America, which is preceded by a sketch of North and South America together, each of the general topics, surface, climate, life, etc., is dealt with for the whole continent, the portion of each of these features that becomes the share of one or another country being pointed out later. In this way are avoided the many repetitions that would be involved in describing separately the geographical characters of the fifty States and Territories of the United States. The facts relating to the products and commerce of a country are also presented from a national standpoint, and comparisons are made with foreign countries. The work is not confined to North America, as might be inferred from a hasty reading of the title; the other grand divisions of the globe are treated with more or less fullness according to their importance to the American pupil. The text is illustrated by seventy well-selected cuts, but unfortunately the pictures have such a muddy appearance that their value is much impaired. In spelling foreign names the authors have followed the rules adopted by the Council of the Royal Geographical Society. The volume is closely printed, and hence contains a great deal of matter within a moderate compass, and different sizes and styles of type, cross-references, foot-notes, and statistical tables have been made use of to link the various descriptions into one connected whole.

A MANUAL OF ANATOMY FOR SENIOR STUDENTS. By EDMUND OWEN, M.B., F.R.C.S. London and New York: Longmans, Green & Co. Pp. 526. Price, $3.50.

FROM its title alone one might infer that this work had about the same scope as others on the same subject prepared for medical students, but it has a somewhat peculiar character, owing partly to what it

omits and partly to what it takes in. The author says in his preface: "Most of the ground has, I am aware, been already covered, especially as regards so-called surgical anatomy. But the entire range of anatomy has not hitherto, I think, been treated from the point of view of the senior student, who, having quitted the dissecting-room, is in need of a volume which shall supply him with such anatomical information, free of wearying detail, as is essential for his successful and intelligent work in the medical and surgical wards and in the special departments of his hospital." He also says: "Having always found it impracticable to draw a hard-and-fast line between facts which bear upon the science of medicine and those which chiefly concern the practical surgeon, I, a surgeon, have presumed in this Manual boldly to trespass upon the domains of the physician, as well as of the specialist." This fact makes the book better calculated to be of use to American students than it otherwise would be, for the medical profession and the public in this country have likewise found it "impracticable to draw a hard-and-fast line" between physicians and surgeons such as exists in England. Accordingly, there is less minute description of parts than in manuals for the dissecting-room, while malformations and disorders, and the operations which these call for, are described more fully than is usual except in the most complete treatises. The style of the book is clear and concise, the text is liberally illustrated, and the mechanical work of the volume is excellent.

HEAT AS A FORM OF ENERGY. By Prof. ROBERT H. THURSTON. Boston: Houghton, Mifflin & Co. Pp. 261. Price, $1.25.

PROF. THURSTON has produced a book for the general reader rather than a text-book for the student. It traces the development of the science of heat from the speculations of the ancient philosophers down to the results of the latest experiments. After stating the ideas of the philosophers in regard to heat, the author gives an outline of the modern science of thermodynamics. In the next chapter he shows how the transfer of heat in various ways is an essential feature in many of the world's important industries, and in many great operations of nature. Most of the latter half of the volume is devoted to the development of heat-engines —machines for transforming heat into mechanical energy. The author is evidently in a favorite field when describing the development of the steam-engine, for he devotes considerable space to this topic, and illustrates the account with pictures of several successive forms of engines. The book is the third of the Riverside Science Series.

The explorations by the United States Fish Commission steamer Albatross during the year 1889 covered a considerable extent of mainland and inland coast waters from California south of Point Conception to Washington. The new discoveries of fishes along the shores of California, Oregon, and Washington were almost wholly from greater depths than fifty fathoms. Of the sixty species of fishes obtained from the Revillagigedos Islands, only about a dozen had been previously recorded there; not more than half were yet known from the mainland; and the other half included new forms and shapes from the islands of the western Pacific and from the Galapagos. The collections from the Gulf of California were obtained mainly along the shores and in the shallower waters of its northern portion. The deeper waters of the Gulf have a bottom of blue mud singularly barren of life. The *Preliminary Report* of Mr. *Charles H. Gilbert* on the fishes collected by the steamer contains descriptions of ninety-two species—all new. *The New Fishes collected off the Coast of Alaska and the Adjacent Region to the Southward* is the subject of a paper by Mr. *Tarleton H. Bean*. Eight of the genera are among the common forms of the Atlantic, and four of them are apparently new to science. Other papers to which the scientific results of the explorations of the Albatross have given rise are a *Catalogue of Fishes collected at Port Castine, St. Lucia*, by *David Starr Jordan*, and a *Catalogue of Skeletons of Birds* collected at points along the South American coast, by *Frederic A. Lucas*. All are published by the United States National Museum.

A description of *Ethcostoma tippecanoe, a New Species of Fish from Tippecanoe River, Indiana*, is described by *David Starr Jordan* and *Barton Warren Evermann*, and figured

in the Proceedings of the National Museum, Washington.

The *Bulletin from the Laboratories of Natural History of the State University of Iowa*, Nos. 3 and 4, contains six papers—viz., Some New Species of Palæozoic Fossils, by S. Calvin; The Saprophytic Fungi of Eastern Iowa, and Common Species of Edible Fungi, by T. H. McBride; The Loess and its Fossils, and A New Species of Fresh-Water Mollusk, by B. Shimer; and the Pselaphidæ of North America, by Dr. E. Brendel and H. F. Wickham. Published by authority of the Regents, at Iowa City.

Among the latest papers left by Prof. *Leo Lesquereux* is one *On Some Fossil Remains considered as Peculiar Kinds of Plants*, which appears as one of the publications of the United States National Museum. It relates to some fossils, one of which, from the Upper Helderberg limestone, Sandusky, Ohio, is like a long, flexuous, tubular stem imbedded in a large piece of compact gray limestone. The others, from the Erie shale near Cleveland, are cylindrical fragments traced in relief upon gray, hard, yellowish, sandy shale, or else short, oval, utricular bodies, rounded at one end, bilobate at the other, found on large flattened pebbles or lenticular masses of argillaceous iron ore, locally distributed in the shale. The author named the fossils *Halymenites Herzeri*, *Cylindrites striatus*, and *Physophycus bilobatus*—all new species.

Prof. *A. H. Mackay* publishes, as a reprint from the Transactions of the Royal Society of Canada, a paper on the *Fresh-Water Sponges of Canada and Newfoundland*. It is intended to be only a synopsis, just sufficient to indicate the extent to which the Spongillidæ of the Dominion have been observed, and to facilitate further investigation. After the introductory general observations on the Spongillidæ, ten species are described, of which *Heteromeyenia pictovensis*, of different lakes in Nova Scotia and Newfoundland, is declared to be the firmest and most beautiful of all the fresh-water sponges in Canada.

The Catalogue of Minerals for Sale by George L. English & Co., Philadelphia (William Niven, New York), fifteenth edition, June, 1890, is a hand-book and bulletin in mineralogy as well as a dealers' list. Besides the ordinary catalogue matter, it contains forty pages of accounts, with illustrated descriptions, of new minerals. The catalogue matter itself is of scientific value, for it includes a complete classified list of all the species described in Dana's System and in the appendixes and the more recent accounts in the American Journal of Science. The pleasant information is given that the present elaborate catalogue is the result of a very great increase in the demand for mineral specimens.

A new theory of *The Origin of Polar Motion* is put forward by *M. Myerovitch*, who attempts to prove that the motion arises from the repulsive power of molecules. The author has published the introduction of his contemplated book on the subject in advance of the book itself, for the information of critics. Rosenberg Brothers, 266 West Twelfth Street, Chicago, Ill.

Zoe, a monthly Biological Journal (Zoe Publishing Company, San Francisco), is filled with contributions of natural-history notes incident and pertinent to the West and the Pacific slope. In a recent number, Mr. Behr's paper on the Economy of Nature as Exemplified by Parasites gives illustrations of the danger of reckless interference with the natural order of affairs. President Jordan accounts for some apparent anomalies in the Distribution of Fishes in the Yellowstone Park. Mr. T. S. Brandegee has some observations on the alternate defoliation and new leafing of *Fouquieria* several times in the season, according to changes in the moisture conditions—a fact that is not unknown with some species on the Atlantic slope. Mr. H. R. Taylor describes some curious incidents of individuality in the nesting habits of the golden eagle.

Among the eight papers in the fifth and sixth numbers of *Studies in the Biological Laboratory of Johns Hopkins University*, Vol. IV, *H. Newell Martin* and *W. K. Brooks*, editors, we notice as of more obvious general interest those of Prof. Martin and Julius Friedenwald on the Effect of Light on the Production of Carbon Dioxide by Frogs; of J. C. Hemmeter on the Effects of Certain Members of the Ethylic Alcohol Series on the Isolated Mammalian Heart; of Prof. Martin and E. C. Applegarth on the

Temperature Limits of the Vitality of the Mammalian Heart; and of S. Watase on the Morphology of the Compound Eye of Arthropods. The articles requiring it are amply and excellently illustrated.

The Journal of Morphology, No. 3, Vol. III, of which *C. O. Whitman* and *W. Phelps Allis* are editors, has four articles—viz.: on the Embryology of the Earthworm, by Edmund B. Wilson; the Ribs and Median Fins in Fishes, and The Morphology of the Vertebrate Skull, by Dr. C. Baur; and a discussion, by Dr. R. W. Shufeldt, of the position of Chamæa (the wren-tit) in the system. They are well illustrated.

Dr. *Michael Foster*, in conducting *The Journal of Physiology*, enjoys the assistance of two English co-operators and of Prof. *H. P. Bowditch*, Prof. *H. Newell Martin*, and Prof. *H. C. Wood*, in the United States. Numbers 1, 2, and 3 of Vol. XI contain thirteen articles relating to bodily temperature, respiration, salivary secretion, the digestive system, the blood, phonation, the nervous system, and knee-jerk. Cambridge, England.

The quarterly *University Studies*, published by the University of Nebraska, for July, 1890, *L. A. Sherman*, editor, contains papers on the Determination of Specific Heat and of Latent Heat of Vaporization with the Vapor Calorimeter, by Harold N. Allen; the Color Vocabulary of Children, by Harry K. Wolfe; and the Development of the King's Peace and the English Local Peace-Magistracy, by George E. Howard. The last is also published separately. In it the author, who is Professor of History in the University, traces the idea of the public peace of the community from the beginning to the re-establishment of popular self-government in the English shire by the act of Parliament of August 13, 1888.

The quarterly *Bulletin of the National Association of Wool Manufacturers* for June, 1890, *S. N. Dexter North*, editor, is devoted chiefly to questions concerning the pending Tariff Bill and its effect on woolens. An article not coming under this description is a History of Wool-combing in England.

It appears from the *Calendar of the Faculty of Medicine of McGill University, Montreal*, that the session of 1890 will be its fifty-eighth, the medical school having been founded in 1824 and suspended during the political troubles from 1836 to 1839. The new building has been found admirably adapted for making the teaching of the primary branches practical and thorough. The session is from October 1st to April, with a summer session of twelve weeks from the middle of April. The school was attended last year by 261 students.

The first number of the first volume of the *Quarterly Review of the United Brethren in Christ*, which is intended to represent the thought of the growing religious denomination of that name, *J. W. Etter*, D. D., editor, appeared in January, 1890. While its articles are intended to and do appeal chiefly to churchmen, we notice as of general interest that of the Rev. J. H. Pershing on the Conemaugh Cataclysm; and as claiming the attention of those who wish to be acquainted with various sides of thought, that of Prof. J. P. Landis on Some Foes of Christianity. The foes described in this article are Pantheism, Materialism, Agnosticism, Rationalism, and Socialism, which are grouped as "anti-theistic theories."

In a paper read by Dr. *G. Brown Goode* before the American Historical Association, on *Museum History and Museums of History*, a historical review is followed by a statement of the author's ideas of what a museum should contain, what purposes it should be intended to serve, and how it should be arranged and managed. The same author's address on the *Origin of the National Scientific and Educational Institutions of the United States* gives a connected view of the growth of such institutions from their beginning in the attempt of Mr. Boyle, Bishop Wilkins, and others to establish in the colony of Connecticut a society for promoting knowledge. A third address by Dr. Goode was delivered before the American Philosophical Society, at the commemoration of the one hundredth anniversary of the death of Benjamin Franklin, and is on his *Literary Labors*. In it Dr Franklin is presented as one who, although standing prominently forth as the only great literary man of America in colonial days and the first fifty years of the Republic, had no thought of obtaining for himself literary fame, but made use of what he gained to promote the welfare of his country.

Prof. *William Watson Goodwin's Syntax of the Moods and Tenses of the Greek Verb* appears from the press of Ginn & Co. in a new edition, rewritten and enlarged from the editions of 1860 and 1865, and so modified by the operation of the author's own criticisms of his earlier effort as to have become to a great extent a new and independent work. A great change has in fact come over the conditions of Greek scholarship during the interval, so that it could hardly be adequately represented in its present state without reconstructing the exposition almost from the beginning. As the author remarks, "few are aware how modern are many of the grammatical doctrines which are now taught in all classical schools." The writings of the Greek authors are full of refinements of style and delicate distinctions which greatly impede the progress of the beginner and make the labor of the advanced student not easy, and on which the ordinary grammars and lexicons cast but a dim light. The purpose of Mr. Goodwin's manual, if we gather it correctly, is systematically to use the full light of the most recent scholarship in explaining them.

The Directional Calculus of Prof. *E. W. Hyde* (Ginn & Co.) is an effort to introduce the system of multiple algebra invented by Hermann Grassmann, and called by him the Theory of Extension. The author has become convinced of the superiority of Grassmann's system to Hamilton's quaternions, in that it is founded upon and is consistent with the idea of geometric dimensions; and that in it all geometric quantities appear as independent units. His directional methods are also believed to be superior to the comparatively awkward and roundabout methods of the Cartesian co-ordinates. While Grassmann's results are all obtained for *n*-dimensional space, Prof. Hyde has, for greater simplicity, restricted the discussion to space of two and three dimensions.

The purpose of Mr. *William Roscoe Thayer's The Best Elizabethan Plays* (Ginn & Co.) is to present specimens of the work of the five Elizabethan dramatists who stand highest among Shakespeare's contemporaries. The selected works are Marlowe's Jew of Malta, Ben Jonson's The Alchemist, Beaumont and Fletcher's Philaster, Fletcher and Shakespeare's Two Noble Kinsmen, and John Webster's Duchess of Malfi. The choice in each case is justified by critical remarks respecting the author and his works, with comparative estimates of the merits of the latter. A general view is presented of the development of the English drama from its rise in Marlowe to its last strong expression in Webster. Its development was urged by the impulsion of the modern spirit which was remolding the society of the Renaissance, added to the great stimulus of the recovered appreciation of classical antiquity. The great poets of the Elizabethan age took all nature for their province. Literary precedents and the conventional rules prescribed by writers of rhetorics and grammars did not hamper them. "Taking the implements at hand—the tedious moralities and the loosely spun miracle plays—they soon improved upon them, soon invented a drama-form not so rigid as to be cramped nor so loose as to be redundant, but articulate like a highly developed organism and as elastic as the various material furnished by nature required. And for their meter they adopted and perfected a line susceptible of almost infinite modulations, suited alike to the simplest narration and to the highest outbursts of passion, and to the most delicate whisperings of fancy."

The Leading Facts of American History (Ginn & Co.) is the title of a generally admirable presentation of this important topic by *D. H. Montgomery*. The work is based on a careful study of the highest recognized authorities. Its purpose is to present, in a clear, connected, and forcible manner, the important events in the history of our country. The author has aimed to be accurate in statement, simple in style, and impartial in treatment. We are glad to observe that military events and politics do not have the first places, but that these are given to social, scientific, and industrial progress, to which they belong. Another commendable feature appears in the brief summaries of most important features attached to each period.

While Mr. *Joseph H. Crocker's* purpose in his essay on *Different New Testament Views of Jesus* has been solely to state the facts respecting the single topic indicated in the title, the author has compiled the paper from the point of view of the supposition that each of the authors of the Gospels had his own ideas of the nature, personality,

and purposes of Jesus, and that this idea is manifested in his narrative; hence that the Christian church has been divided on these subjects from the very beginning.

Mr. *George W. Childs* publishes a booklet, small enough for the pocket and large enough to serve for an evening's reading, of *Recollections of General Grant*, with an account of the presentation of the portraits of Generals Grant, Sherman, and Sheridan at the Military Academy, West Point. (Collins Printing House, Philadelphia.)

The *Annual Report of the State Board of Charities* (New York) for 1889, besides the general account of the charitable institutions of the State, comprises special reports of the investigation of the Rochester Orphan Asylum; on reformatories; on the deaf and dumb; on the State Soldiers' and Sailors' Home; on dependent children; and on the condition of children in asylums.

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POPULAR MISCELLANY.

California and its Mines.—The trustees of the California State Mining Bureau find in the increasing demands for their report evidence that the institution is fulfilling a public want and is growing in public favor. The edition of the sixth annual report is exhausted, and that of the seventh nearly so, while the edition of the eighth was nearly doubled. A historical fact of much significance is embodied in the statement that while in the early days the newspapers of the State teemed with notices of mining interests which were summarized at regular intervals in quarterly and annual reviews, the articles of that kind have been gradually curtailed as the relative importance of the mines diminished and other interests pushed themselves into prominence, till now they appear, if at all, as mere items. Hence the Mining Bureau has become the only center and the best source of information on the subject. A complete review of the mines and mining operations was given for the first time in the report for 1888. The report for 1889 assumes that the whole country owes very much of its prosperity to mining. Every State owes that industry something; the mid-continental regions almost their very existence. Mining investments are among the most profitable, notwithstanding an impression to the contrary prevails. The impression that the gold-mines of California are depleted below the point of profitable production is likewise mistaken. The gold taken out has exhausted but little of the auriferous wealth of the State, and the annual production has not heretofore much exceeded what it may be reasonably hoped to reach and maintain in the future. Besides its gold-fields and silver-bearing lodes, California possesses the more common metals and minerals in great variety. There is hardly a county in the State but has valuable mineral deposits of one kind or another, and the distribution of these products is pronounced remarkable. Fourteen of the fifty-three counties make a notable production of gold, and twelve of gold and silver; five produce quicksilver, two borax, two salt, four asphaltum, two petroleum, three copper, etc. Were California even poor in the precious metals, it would yet become a great mining State. It is asserted in the report that gold-mining has not yet reached even the stage of sturdy infancy.

Caprices of Soils.—The system of studying the adaptation of soils to crops has grown out of the failure of attempts to settle such questions in the laboratory. This work, as is shown in a Bulletin of the Ohio Experiment Station, is attended with great difficulties. "So great is the variation in natural fertility in soils that appear to the eye to be identical in composition, that the results of field experimentation are liable to be even more misleading than those of the laboratory. Take any single acre of ground for illustration. An open glade in the original forest may have permitted the wind to sweep away its winter coverlet of leaves, and they may have lodged in a thicket of underbrush adjoining, carrying stores of potash and phosphoric acid with them. Such a glade may have been for centuries the pasturing ground of deer. It would then accumulate nitrogen, but would lose potash and phosphoric acid through an additional channel, while the thicket would accumulate these in excess of nitrogen. The growth of a surface-rooting tree in one spot may have drawn upon the adjacent surface-soil for supplies of potash; that of a tree with a deep tap root in another may have drawn its support largely from deeper layers of the soil, and also have opened a way for drainage. A slight depression of the soil here may have received added fertility in the waste from a slight elevation there, and he who has studied the soil carefully, especially where its levels are shown by the melting of snow when the ground is frozen, will have detected irregularities of level unsuspected by the casual observer."

Firing Pottery Kilns by Gas.—A new method of firing kilns by gas has been introduced at one of the Trenton, New Jersey, potteries by the use of which the expense of baking the ware is greatly reduced. It is dependent on the principle of preheating the air before it enters the kiln, so that a perfect combustion is secured, with no loss of heat. Gas generated outside the building is forced through an underground flue to the center of the kiln, whence it is carried by branch channels to the several mouths around the side of the kiln. There it is combined with air, and combustion takes place. The heated air then passes upward, and, instead of escaping out of the chimney, it is drawn down a well-hole through the center of the kiln and passes down and around the channel at the base of the kiln in the opposite direction from that in which it entered, and to near where it entered. After some time the dampers are reversed, so that the cold air enters the channel through which the heated air from the kiln has been passing toward the chimney, and the heated air escapes by the opposite passage. The cold air is thus heated some 1,000 or 1,500 degrees by passing through the heated channel, with the saving of much heat that was formerly wasted by passing immediately out of the chimney. The dampers are reversed every half hour, whereby the cold air is at every turn passed through a freshly heated chamber.

Some Advantages of Wild Life.—The two great points of superiority of the native or savage soldier over the representative of civilized discipline, says Captain John G. Bourke, in his An Apache Campaign in the Sierra Madre, are his absolute knowledge of the country and his perfect ability to take care of himself at all times and under all circumstances. Though the rays of the sun pour down from the zenith, or the scorching sirocco blow from the south, the Apache scout trudges along as unconcerned as he was when the cold rain or snow of winter chilled his white comrade to the marrow. He finds food, and pretty good food too, where the Caucasian would starve. Knowing the habits of wild animals from his earliest youth, he can catch turkeys, quail, rabbits, doves, or field-mice, and perhaps a prairie dog or two, which will supply him with meat. For some reason he can not be induced to touch fish, and bacon or any other product of the hog is eaten only under duress; but the flesh of a horse, mule, or jackass, which has dropped exhausted on the march and been left to die on the trail, is a delicious morsel which the Apache epicure seizes upon wherever possible. The stunted oak, growing on the mountain flanks, furnishes acorns; the Spanish-bayonet, a fruit which, when roasted in the ashes of a camp-fire, looks and tastes something like the banana. The whole region of southern Arizona and northern Mexico is matted with varieties of the cactus, nearly every one of which is called upon for its tribute of fruit or seed. The broad leaves and stalks of the century-plant—called *mescal*—are roasted between hot stones, and the product is rich in saccharine matter and extremely pleasant to the taste. The wild potato and the bulb of the *tule* are found in the damp mountain meadows; and the nest of the ground-bee is raided remorselessly for its little store of honey. Sunflower-seeds, when ground fine, are rich and nutritious. Walnuts grow in the deep ravines, and strawberries in favorable locations; in the proper season these, with the seeds of wild grasses and wild pumpkins, the gum of the *mesquite*, or the sweet, soft inner bark of the pine, play their part in staving off the pangs of hunger. The above are merely a few of the resources of the Apache scout when separated from the main command. When his moccasins give out on a long march over the sharp rocks of the mountains or the cutting sands of the plains, a few hours' rest see him equipped with a new pair—his own handiwork—and so with other portions of his raiment. He is never without awl, needle, thread, or sinew. Brought up from infancy to the knowledge and use of arms of some kind—at first the bow and arrow, and later on the rifle—he is perfectly at home with his weapons, and, knowing from past experience how important they are for his preservation, takes much better care of them than does the white soldier out of garrison. He does not read the newspapers, but the great book of nature is open to his perusal, and has been drained of much knowledge which his pale-faced brother would be glad to ac-

quire. Every track in the trail, mark in the grass, scratch on the bark of a tree, explains itself to the "untutored" Apache. He can tell to an hour, almost, when the man or animal making them passed by, and, like a hound, will keep on the scent until he catches up with the object of his pursuit.

The Pine Belt of New Jersey.—The "pine belt" of New Jersey is described by Dr. I. H. Platt as a strip of land about sixty miles long by from eight to twenty miles wide, reaching from a few miles south of Freehold almost to Vineland. Its soil varies from a light, sandy loam to clear beach sand. Its streams, which are sufficient for drainage, have good banks which they rarely if ever overflow, and there is no wet meadow. There are a few peat-bogs, some marl-beds, and occasionally a cedar swamp, but these features are all of very limited extent. The belt comprises in all about five hundred and seventy square miles, and has a population of 14,475 persons. The region has long enjoyed a local reputation for healthfulness, and some parts of it have been mainly settled by people who have sought it for that reason. According to the reports of the State Board of Health, its average death-rate during the six years, 1883 to 1888, inclusive, was 12·65 per thousand, against 18·65 per thousand for the whole State, or 15·07 for the State excluding cities; and the death-rate from consumption was 1·60 against 2·53 and 2·12. The comparatively low mortality from consumption is the more striking when we recollect the extent to which the region is sought by persons in feeble health.

The Mouth-slitting Botocudos.—A monograph on the Botocudos of Brazil and their ornaments has been published by Dr. John C. Branner, in a reprint from the papers of the American Philosophical Society. It is illustrated by photographs showing the manner of wearing the ear- and mouth-plugs from which the tribe derive their name (*botoque*, lip-ornament), the appearance of the slits when they have been torn, and the younger members of the tribe who have ceased to practice the mutilation, or have reduced it to the simple wearing of earrings. Mr. John Stearns said, in a paper before the Royal Geographical Society, on the Exploration of the Rio Doce and its Tributaries, that the custom of these Indians of slitting the lower lip for the purpose of inserting a wooden ornament in it has been described by visitors to the American coasts from Cabral down. When Cabral sent a boat ashore in Brazil to investigate the country, the men told him on their return that they did not believe the natives were men, though they were dressed up in feathers and painted in colors, for they had two mouths. The Indians were accustomed to take out the lip ornaments, and, while the teeth were grinning from the upper mouth, to push out the tongue from the lower one. Cook, two hundred and eighty years later, at Prince William's Sound, Alaska, heard one of his sailors say to another, "Come here, Jack, look at the men with two mouths." A writer of that period tells of the wife of a great chief at Sitka, that by a singular motion of the lower lip she could raise it in such a way as almost to cover the whole of her face. Mr. Colin Mackenzie has cursorily followed out the geographical line of this singular custom, and has found that it could be traced, with very few breaks, from Alaska to the coast of Brazil.

Medicinal Plants.—The pamphlet of Mr. Charles Mohr, on The Medicinal Plants of Alabama, besides the list of the plants, with notes on their distribution and the proper time of collecting the parts used, contains some facts of interest respecting the flora of the State and the home of its medicinal plants. The flora of Alabama includes a majority of the plants noted for their remedial value which are found in North America east of the Rocky Mountains. The plants furnishing drugs of the greatest importance have their home principally in the woodlands of deciduous-leaved trees in the northern section of the State. With the enormous decrease of the forest area north of the Ohio River that has taken place during the last thirty-five years, the supply of crude drugs furnished by that territory has been correspondingly reduced. The resources existing in the more elevated regions of the South have consequently been resorted to. Within the past ten or fifteen years North Carolina has become the center of the most active trade in this line, which is gradually

extending farther south, and operations have been successfully begun in the northern section of Alabama. This region offers a promising field for the enterprise, with the prospect of supplies to last for a long time to come. Particularly in the mountainous and hilly districts, extensive tracts, unfit for the cultivation of the soil, will probably remain, if not violently interfered with, in the condition of woodlands. "Thus we find the interest of the healing art closely connected with the question of the preservation of the forests of our country, and the pharmacist should feel in duty bound to unite his efforts with those who are already striving to secure this important object."

The Doctrine of Spirits in New Guinea.—The natives of British New Guinea, according to Mr. H. H. Romilly, believe that human appetites remain with the spirits of their deceased friends, just as if the body had not died. Hence the spirit must be kept supplied with food and water at the grave and in the accustomed haunts of the dead man. But if he has been killed in battle, the head of one of the enemy's tribe or race is sufficient; and if the slayer is a white man, the spirit can be appeased by payment in goods. They regard dreams as voices from the land of spirits, telling them what to do, for whom to work, from whom to plunder, and what to steal. When any mischief befalls a place where a white man happens to be, the blame is laid upon his attendant spirit, and the injury must be atoned for—by payment if he is a friend, or otherwise if not. Certain trees are supposed to have spirits, for which a part of the food or feasts is set away. It is noteworthy that all these spirits are malignant, and the savages do not seem able to grasp the idea of a beneficent spirit. They have to be overcome by force of arms, blessings, or cursings, but are most effectively dispelled by fire. They can not be seen, but use arrows and spears when they are vexed. Sorcerers are guarded against by wearing charms, the character of which is regulated largely by the fancy of the sorcerer or the purchaser. Sometimes the charm is a bit of bark, sometimes it is a fantastically worked crab's claw; but great faith is reposed in its potency.

Lepidosirens.—The *Dipnoi*, one of the oldest types of water animals, are now represented by only four species: *Lepidosiren paradoxa*, a very rare species inhabiting the river Amazon; two species of *Ceratodus* or *Barramunda*, plentiful in certain rivers of Australia; and *L. annectens*, which is the most abundant, being found throughout tropical Africa. The lepidosiren, or "African mud-fish," has a somewhat eel-shaped body and four limbs, which are round and taper to a point, being the simplest form of limb known. The breathing-organs consist of both gills and lung-like sacs; the skeleton is part cartilage and part bone; the nostrils, of which there are two pairs, are placed within the opening of the mouth. It is the organ of smell which determines that the lepidosiren is a fish and not a reptile. In every fish this organ is a short sac opening only upon the outer surface of the body; in every reptile it is a canal with both an external and an internal opening. Though lepidosirens are without doubt fishes, they spend a considerable part of their existence out of the water, as they inhabit shallow waters which periodically dry up. During the dry season they inclose themselves in balls of clay, which are lined with mucus, and have a small hole at each end to admit air. In these they remain torpid until the rains refill their pools. Lepidosirens attain a length of from three to six feet; they are carnivorous, feeding on frogs, fishes, and other aquatic animals.

Indian Tribes of the Amazon.—Of the Indian tribes of the Amazonian river Purus, the Pammarys are described by Dr. P. Ehrenreich as being pure water-men. Most of their life is spent in their canoes, and they are conspicuous by a peculiarity of their skin, which is covered with black and white spots that cause many of them to look as if they were dappled. The same skin affection exists among other tribes of the western Amazons, and is very mysterious. The Pammarys are industrious collectors of caoutchouc and copaiva, and have provided themselves with many European articles of commerce. The Jamamadis make their homes in the forests; are without a knowledge of navigation; are clever agriculturists; avoid trade with the settlers, and seldom leave their dense forests.

They are still an uncorrupted, hospitable, frank, natural people. Their principal weapon is the blow-pipe, discharging poisoned arrows. The most important nation on the Purus are the Ipurinas, or Cangiti, who dwell in numerous hordes, under different names, in the head-water regions. They are a proud, warlike race, of vindictive disposition, cunning, and treacherous. They are still partly anthropophagous. Domestic animals are rarely kept among them; tobacco is taken as snuff; and poisoned weapons are generally used. In the region of the source of the Rio Acre other Indian races of great interest to ethnologists dwell, possessing richly carved huts for ceremonies, stone figures, and idols. The caoutchouc trade, with its reckless gains, exercises a most disastrous effect upon the Indians; nevertheless, that element might become of the highest importance to the immense but thinly peopled province of the Amazon, if only a judicious and conscientious treatment was adopted as the means of bringing the aborigines within the bounds of civilization.

The Pallas Cormorant.—Pallas's Cormorant, or the great spectacled cormorant (*Phalacrocorax perspicillatus*), has gone to keep company with the great auk, as a bird that has become extinct within the last forty or fifty years. It is so rare in collections that only four specimens are known to exist in museums, no one has its eggs, and no bones had been found or preserved till Mr. Leonhard Stejneger collected a few of them some years ago on the Commander Islands. It was reported very abundant on Bering Island by Steller in 1741, and the only material for Pallas's description of it was derived from his observations. The specimens in the British, St. Petersburg, and Leyden Museums were obtained from a governor of Sitka, and these are all that are known to be in existence. Several pictures of the bird have been published. Mr. Stejneger was informed by the natives of Bering Island that the meat of this species was more palatable than that of its congeners, and was used as food in preference to any other. According to Steller, the weight of the cormorant varied from twelve to fourteen pounds, so that one bird was sufficient for three starving men of his shipwrecked crew. The value of the cormorant as food, and its sluggishness, contributed to its extermination. The bones found by Mr. Stejneger have been examined and described by Mr. Frederick A. Lucas; and a full account of them, with the history of the bird, is given in a reprint from the proceedings of the National Museum.

Relative Abundance of the Chemical Elements.—An estimate of the relative abundance of the chemical elements in the atmosphere, ocean, and that part of the crust of the earth which is accessible, has been made by Prof. F. W. Clarke. Separate calculations are made for the atmosphere and the ocean. The estimate of the constitution of the crust is made from the means of 880 analyses of volcanic and crystalline rocks from different places of the United States and Europe. Averaging the whole, the author finds oxygen constituting 49·98 per cent; silicon, 25·30 per cent; aluminum, 7·26 per cent; iron, 5·08 per cent; calcium, 3·57 per cent; and after these, in order, magnesium, sodium, potassium, hydrogen, titanium, carbon, chlorine, bromine, phosphorus, manganese, sulphur, barium, nitrogen, and chromium. Other substances are supposed to be present in less proportions than five one-hundredths of one per cent. The most surprising feature in the estimate is the relative abundance of titanium, which is placed before phosphorus, manganese, and sulphur. It is, however, rarely absent from the older rocks; is almost universally present in soils and clays; and is often concentrated in great quantities in beds of iron ore. Having no very striking characteristics and but little commercial importance, it is easily overlooked, and so has a popular reputation for scarcity which it does not deserve.

The Summit of Kilima-njaro.—The ascent to the summit of Kilima-njaro, the highest mountain in Africa, was accomplished by Dr. Hans Meyer in October, 1889. The base of the ice-cap of Kibo was reached at 18,270 feet above the sea. The upper part of this ascent was extremely toilsome, as the surface of the ice became increasingly corroded, taking the form which Gussfeldt, on Aconcagua, in Chili, called *nieve penitente;* honeycombed to a depth of over six feet,

in the form of rills, teeth, fissures, and pinnacles. The travelers frequently broke through as far as their breasts, with an alarmingly rapid diminution of their strength. Reaching the summit of the ridge, they found the precipitous walls of a gigantic crater yawning beneath them, with the loftiest elevations in the shape of three pinnacles rising above the ice on its southern brim. These they calmly and systematically climbed one after the other. The central pinnacle reached a height of about 19,700 feet, overtopping the others by 50 or 60 feet. Dr. Meyer was the first to tread this peak, and planted the German flag upon it, christening it Kaiser Wilhelm's Peak. The diameter of the crater measured about 6,500 feet, and its depth was about 600 feet. In the southern portion the walls of lava were of an ash-gray or reddish-brown color, and were free from ice; in its northern half the ice sloped downward from the upper brim of the crater in terraces, forming blue and white galleries of varying steepness. A rounded cone of eruption, composed of brown ashes and lava, rose in the northern portion of the crater to a height of about 500 feet, which was partly covered by the more than usually thick sheet of ice extending from the northern brim of the crater. The large crater opened westward in a wide cleft, through which the melting water ran off, and the ice lying upon the western part of the crater and the inner walls issued in the form of a glacier.

Artists in Humble Work.—Among the ancient Greeks and the northern Italians of Renaissance days, says Prof. G. Aitchison, in a lecture on Decoration, beauty was adored. Every man who practiced a craft was as sure of fame, if he followed what we now call a humble one, as if he followed a noble one, provided that the articles he made could be endowed with beauty, and that he possessed a certain high degree of excellence. A carpenter, an armorer, a potter, a goldsmith, a lapidary, or a bronzer, was as certain to be famous as a sculptor, a statuary, a painter, or an architect. "We naturally know less about the ancient Greeks than about the Italians, though, from Socrates being a sculptor, we hear something of the crafts, and we know that Phidias was not only a sculptor and statuary, . . . but worked also in ivory and gold. The great Italian artists were almost invariably craftsmen as well; in fact, had begun as craftsmen and had learned during their apprenticeship precision in the use of tools and in workmanship as well as precision in drawing and modeling. As a rule, every youth who wanted to be a painter, sculptor, or architect, was apprenticed to a goldsmith. Brunelleschi, Michael Angelo, and Benvenuto Cellini were all brought up as goldsmiths; one became an architect, one a sculptor and painter, and one a statuary and die-sinker; Ghirlandaio got his name from the golden wreaths he made, and Francia . . . signed his pictures as a goldsmith, while he signed his goldsmith's work as a painter, and, like the French artists of the present day, these artist craftsmen were often excellent shots and swordsmen as well. If he can invest the article he works at with the highest form of beauty, he is just as much an artist as he who paints a picture, models a statue, or designs a building."

Messrs. Heilprin and Baker's Survey of Mexico.—Prof. Angelo Heilprin and Mr. Frank C. Baker have recently returned from a scientific expedition to Mexico, which they undertook in February, 1890, in connection with the Academy of Natural Sciences of Philadelphia, and are preparing a paper giving the results of their explorations. It is represented that the main purpose of the expedition—the determination of the physical relations of the Gulf border—was successfully accomplished. The principal volcanoes—Orizaba, Popocatepetl, and Ixtaccihuatl—were ascended; and more exact measurements than have been made before gave Orizaba as the highest of the three, at a little less than eighteen thousand feet, instead of Popocatepetl. An entirely new view is taken by the explorers of the structure of the great central plateau. Instead of being an integral part of the Cordilleran system or a volcanic output, it is mostly a flooded expanse of lava and ash, which has covered over the Cretaceous system of rocks and mountains that constitute a nucleus to the plateau. Immense deposits of fossiliferous limestone, manifestly a part or continuation of the Cretaceous system of the United States, crop out around the borders of the

plateau, and at points within the same, capped by the covering of lava and ash. The explorations of Yucatan did not lend support to the supposition that the banks have been built up through simple organic accretion. The evidences of recent uplift were abundant, and it further appeared that a gradual subsidence followed the elevation.

Geometry of Aboriginal Mounds.—In his paper on the Circular, Square, and Octagonal Earthworks of Ohio, Mr. Cyrus Thomas gives the results of recent surveys of those works, and corrects the errors into which Squier and Davis fell in exaggerating the geometrical accuracy of the structures. The close approximation to such regularity in certain of the square and circular works is admitted as beyond question; but none of them are perfect, while the octagons are less regular. Their characteristics are pronounced essentially aboriginal. There is nothing in them or connected with them contradictory to the theory of their Indian origin except it be the single fact that a few of them approached very nearly to true geometrical figures. It is admitted both that Indians can lay out true circles of moderate size, and that they are less able now to perform many things which necessity formerly compelled them to practice. No valid reason can be presented why Indians taught by necessity and practice could not lay off by the eye and by means at hand figures with which they were familiar more correctly than the white man without instruments.

An Indian Ball-Player's Training.—As described by Mr. James Mooney, the training of the Cherokee ball-players includes a course of precautionary measures. "They bathe their limbs with a decoction of *Tephrosia Virginiana*, or catgut, in order to render their muscles tough like the roots of that plant. They bathe themselves with a decoction of the small rush (*Juncus tenuis*), which grows by the roadside, because its stalks are always erect and will not lie flat upon the ground, however much they may be stamped and trodden upon. In the same way they bathe with a decoction of the wild crab-apple, or the iron-wood, because the trunks of these trees, even when thrown down, are supported and kept from the ground by their spreading tops. To make themselves more supple, they whip themselves with the tough stalks of the *wdtakú*, or star-grass, or with switches made from the bark of a hickory sapling which has grown up from a log that has fallen across it, the bark being taken from the bend thus produced in the sapling. After the first scratching the player renders himself an object of terror to his opponent by eating a rattlesnake which has been killed and cooked by the shaman. He rubs himself with an eel-skin to make himself slippery like the eel, and rubs each limb down once with the fore and hind leg of a turtle, because the legs of that animal are remarkably stout. He applies to the shaman to conjure a dangerous opponent so that he may be unable to see the ball in its flight, or may dislocate a wrist or break a leg. Sometimes the shaman draws upon the ground an armless figure of his rival with a hole where the heart should be. Into this hole he drops two black beads, covers them with earth, and stamps upon them, and thus the dreaded rival is doomed, unless (and this is always the saving clause) his own shaman has taken precautions against such a result, or the one in whose behalf the charm is made has rendered the incantation unavailing by a violation of some one of the interminable rules of the *gaktunta*."

NOTES.

Prof. Huxley was the recipient of the Linnæan medal at the anniversary meeting of the Linnæan Society on Saturday, May 24th. This medal was instituted three years since, with a view of conferring honor on distinguished biologists. In replying to the president, Prof. Huxley said the aim of his life had been in the words of the motto of the society: "Naturæ discere mores" (to learn the ways of nature). He had endeavored to show the fundamental unity of plant life and of animal life; to make use of hypotheses as ladders or scaffoldings to be discarded, perhaps somewhat ungratefully, when no longer of use; and to pursue truth regardless of incidental consequences.

In order to investigate their botanical and medical knowledge, and the theories on which their practice is based, Mr. James Mooney spent several weeks in intimate association with the Cherokee doctors. He concluded that the aggregate botanical knowledge of the whole profession is represented by about eight hundred species;

but no one doctor knew the names of three hundred species. Many of the most common plants and brightest flowers have no Cherokee names, for the Indians do not use them for food or medicine. Yet their country—the mountain region of western North Carolina—can probably furnish two thousand species of plants. The Indian has no appreciation of the beauty or fragrance of a flower.

An extract from a lecture by J. Lewis Smith, M. D., of Bellevue Medical College, on Growing Pains, contains some very valuable cautions. He says the pains in the limbs experienced by many children, and attributed to rapid growth, are very commonly slight attacks of inflammatory rheumatism, a dangerous and painful disease when occurring in an adult.

The practice of cremation in place of ordinary burial is making steady progress in Paris, in spite of the opposition to it which exists in certain quarters. At the new crematorium of the cemetery "Père-la-chaise" a furnace is in operation which will reduce a body to ashes in less than an hour, at a cost of about thirty cents for fuel. Since the establishment of this system in the French capital twelve hundred unclaimed bodies of persons who have died in hospitals have been thus disposed of, besides the bodies of three hundred of the well-to-do classes, whose wishes have been thus complied with.

A description is published by T. H. Lewis of the sculptured figures on a rock of the Potsdam sandstone on the bank of the Trempeleau River, near Trempeleau, Wisconsin. The figures consist chiefly of representations of the hand and foot many times repeated, crescent-shaped figures called canoes, and what appears to be a fort. They are cut very smoothly into the rock to the depth of from a quarter of an inch to an inch, and are in perfect preservation.

A mixture of sixty parts of chloride of sodium and forty parts of cryolite or double fluoride of aluminum and sodium having been melted at a temperature of from 850° to 1,100° C., was submitted to electrolysis by M. Minet. Metallic aluminum flowed out of the cathode, which was in charcoal, into a crucible, whence it was extracted at the close of the operation. The author produced in this way, in twenty-four hours, 5,250 grains of metallic aluminum.

Prof. Arthur Dodel, of the University of Zurich, says that he has observed, of his students in botanic microscopy, that the average of those from America drew better than those from Europe of the same age who competed with them. To this he would add the circumstance that in America, during the last two years, the technique of reproduction has made more progress than in any other part of the world. For the cause of this excellence, Prof. Dodel refers to the method of the instruction in drawing in the primary and intermediate schools. "It will not be surprising," he adds, "if this vigilant nation finally surpasses us, and also puts us in the shade in the field of artistic painting and sculpture. This I call an enjoyable danger, and greet it in advance in the interest of the general welfare of humanity."

The commission appointed to consider the question of coal-waste in the State of Pennsylvania has sent out a circular of inquiries on topics relating to the investigation it has undertaken. The questions come under three categories, of Geological and Statistical Waste, Waste of Producing and Marketing, and Utilization of Coal Waste. Under the first head are questions relating to the amount, annual production, and natural wastes of the coal-beds. The second heading includes the waste incurred in preparing the coal for market, the amount of culm, etc. The third head embraces the Briquette system of preparing the waste for use; the appliances by which it is utilized without mechanical preparation; and the gasifying processes and use in the destruction of garbage or cremating work, and in agricultural experimentation.

Mr. David P. Todd, of the Smithsonian Institution, has made a report of progress in an investigation in which he is engaged of the variations of the elements of terrestrial magnetism. Since the demonstration that the direct influence of the sun and the moon upon the earth, each being considered as magnets, is inappreciable, all attempts to construct a theory of terrestrial magnetism have been confined to causes within the earth's atmosphere. These efforts—the aim of which has been to constitute currents by friction in the earth's crust, or in the atmosphere by changes of density and humidity—have failed to account for the periodic nature of the phenomena. Consequently, the vast masses of magnetic observations already accumulated are unconnected by any proposed combination of natural laws. It appears, however, that one cause of vital importance has been omitted from the elements of the problem, namely, the motion of the earth, as referred to the ether in its neighborhood; and the author proposes to base an explanation of terrestrial magnetism upon the dynamic effects produced by the inductive action of the earth in its motions of rotation and translation through fields of force—or, by regarding the earth as a cosmical dynamo.

Some new and remarkable results are described by M. Friedel as following the action of alkalies and alkaline silicates on mica under the double influence of water and a high temperature. With potash and the brown mica called muscovite, numerous crystals of

nephiline were prepared—a mineral which had never before appeared from manipulation with water. Better success was had when soda was substituted for potash; and in every case a product of simple and fixed composition was obtained. Adding a suitable proportion of chloride of sodium, sodalite was formed, and proved to be of definite composition, and not, as some mineralogists believed, a mixture of nephiline and an alkaline chloride. With mica and silicate of potash crystalline orthose feldspar was obtained, and, with a smaller proportion of silicate, amphigene. The intervention of chloride of calcium determined the crystallization of anorthite.

In view of the greatly augmented demand for camphor for the new uses that have been found for it in the arts, with consequent enhancement of price, it is proposed to use naphthalin as a substitute for it in anti-moth applications. It is quite as effective as camphor, and being also equally volatile, leaves no more permanent smell.

Mr. E. T. Chaplin tells, in the London Spectator, how, by hypnotizing her, he induced a laying hen, which had manifested no disposition in that direction, to sit on a sitting of eggs till seven of their number were hatched into "healthy, happy little chickens."

Bisulphide of carbon is recommended by Mr. A. J. Cook, of the Michigan State Agricultural Experiment Station, as one of the very best insecticides. It has been used with success to destroy the phylloxera on the grape-vines of France; is applied to the destruction of prairie-dogs in the West; and has been used by Mr. Cook with success to destroy ants. A single dose in the habitation of the animal, or in an apartment, is usually sufficient. It is exceedingly volatile, and its vapor reaches everywhere. But it must be used with great care, for the vapor is very inflammable and poisonous; so that a room in which it is used must be well aired before one enters or carries a light into it.

A considerable portion of the Second Annual Report of the Maryland Agricultural Experiment Station is devoted to the tomato. The record of the experiments with this fruit is preceded by a valuable paper on the history of the tomato, by Dr. E. Lewis Sturtevant.

A quick and easy method for determining whether or not a fabric is "all wool" is given in the Lancet. This is to separate the warp from the woof, and to hold each to a flame. Wool burns into a shapeless mass, and no threads can be traced in its ash. If removed from the fire before it is all burned, it ceases to blaze; cotton, on the contrary, continues to burn steadily, and its ash retains the shape of the thread.

A redwood-tree, ninety feet in circumference and thirty-three feet in diameter, is being cut for the Chicago exhibition. The section to be sent to Chicago will be nine feet in height and sixty feet in circumference, and will weigh sixty-five thousand pounds. The tree is taken from the forests of Tulare County, California.

OBITUARY NOTES.

Prof. C. H. F. Peters, Director of the Litchfield Observatory of Hamilton College, Clinton, N. Y., died July 19th, in his seventy-seventh year. He was a native of Sleswick, and had been in the observatory directorship more than thirty years. He was the discoverer of forty-seven asteroids, his last discovery in that line being that of Nephthys, in August, 1889. He was chief of the party which observed the total eclipse of the sun at Des Moines, Iowa, August 7th, 1869; and also of the party that observed the transit of Venus in 1874 in New Zealand.

Charles Grad, an eminent Alsatian student of science, died at Logelbach, July 5th, in the forty-eighth year of his age. He was one of the earliest contributors to *La Nature*, and continued his active relations with that journal as long as his health permitted. His first scientific papers were in geology. Many of his contributions related to Alsatian matters of scientific interest.

William Kitchen Parker, an eminent English biologist, died suddenly in Cardiff, Wales, July 3d. He was drawn to the study of nature and to experimenting on plants and animals at a very early age; was the author of a number of valuable papers (1856–1873) on foraminifera, and made communications to the Zoölogical and Royal Societies on birds and animals, his last work, on The Duck and the Auk, having been published in the present year. He was a member of several scientific societies, British and foreign; was for many years a Hunterian Professor at the Royal College of Surgeons; and was the author of books on the Morphology of the Skull and on Mammalian Descent. Two of his sons are Professors of Biology, at Cardiff and in Otago, New Zealand.

The death is announced of Alexander von Bunge, Professor of Botany in the University of Dorpat, at the age of eighty-seven years. He made a scientific voyage to China in 1830; and was principally interested in the flora of Russia and northern Asia.

M. Alphonse Favre, formerly Professor of Geology at Geneva, has recently died, seventy-seven years old.

M. Paul Loye, who recently died in France, was the author of a memoir on the physiology of death by decapitation, and had published short notes on physiological questions.

INDEX TO VOLUME XXXVII.

INDEX.

ARTICLES MARKED WITH AN ASTERISK ARE ILLUSTRATED.

PAGE

Aber, Mary Alling. Mothers and Natural Science..... 788
Advantages of Wild Life, Some. (Misc.)..... 857
Agnosticism, The Affirmative Side of. J. A. Skilton: with Letters from Herbert Spencer, T. H. Huxley, and Lyman Abbott..... 217
Agriculture on the Plains. (Corr.). A. E. Harvey..... 122
Alviella, Count Goblet d'. The Migration of Symbols..... 671, 778
American Association, The. (Editor's Table)..... 843
Ancient Dwellings of the Rio Verde Valley.* E. A. Mearns..... 745
Ancient Men of the Potomac. (Misc.)..... 570
Animal and Plant Lore. III. Mrs. F. D. Bergen..... 240
Animals, Recognition of Pictures by. (Misc.)..... 426
Antiquity of Man, The, and Egyptology. A. D. White..... 145
" " and Prehistoric Archæology. A. D. White..... 289
Apparatus-Making in Education.* M. C. Wilson..... 845
Architecture, Utility in. B. Ferree..... 202
Arizona, Mountains of. (Misc.)..... 567
Art, Fine, in the Workshop. (Misc.)..... 572
Artists in Humble Work. (Misc.)..... 861
Asphalt in Building Construction. (Misc.)..... 715
Association, The American. (Misc.)..... 571
Astronomy on Lake Tanganyika. (Misc.)..... 427
Atkinson, Edward. Common Sense applied to the Tariff Question..... 433, 591
Atmospheric Dust. W. Marcet..... 177
Australasia, Some Natives of.* E. Reclus..... 607
Avogadro. (Misc.)..... 141

Ball, A Little Boys' Game with a. H. J. Philpott..... 650
Barrier Beaches of the Atlantic Coast. F. J. H. Merrill..... 786
Beaman, George W. Secondary School Programmes..... 48
Beet-Sugar in Germany. (Misc.)..... 430
Bellamy, Miss Elizabeth W. A Queer Pet*..... 528
Bergen, Mrs. Fanny D. Animal and Plant Lore. III..... 240
Books noticed:
Abbot, Francis E. The Way out of Agnosticism..... 416
Allen, Alexander V. G. Jonathan Edwards..... 129
Allen, Harrison. A Clinical Study of the Skull..... 560
American Society of Naturalists. Records, Vol. I, Part 7..... 707
Appleton, John H. Laboratory Year-Book..... 133

Books noticed: PAGE
Arey, Albert L. Laboratory Manual of Experimental Physics..... 559
Bainton, George. The Art of Authorship..... 699
Barkan, Louis. How to preserve Health..... 418
Billings, John S. The National Medical Dictionary..... 180
Blackmar, Frank W. Spanish Colonization in the Southwest..... 705
" The History of Federal and State Aid to Higher Education in the United States..... 135
Bloxam, Charles L. Chemistry: Inorganic and Organic..... 560
Bonham, John M. Railway Secrecy and Trusts..... 134
Boole, Mary. Logic taught by Love..... 419
Brace, C. Loring. The Unknown God..... 556
Bray, Henry Truro. The Evolution of a Life..... 135
Brinton, Daniel G. Essays of an Americanist..... 413
" Etruscan and Libyan Names..... 561
" The Cradle of the Semites..... 708
Canadian Institute. Report of the Council for 1888–'89..... 278
Catalogue of Minerals, for sale by George L. English & Co..... 852
Childs, George W. Recollections of General Grant..... 855
" and C. H. Leete. Longman's School Geography for North America..... 850
Chisholm, George G. Handbook of Commercial Geography..... 277
Church, A. H. The Chemistry of Paints and Painting..... 559
Commissioners of the State Reservation at Niagara. Report for 1888–'89..... 708
Constitutional History of the United States, as seen in the Development of American Law..... 134
Cornell University. First Annual Report of the Agricultural Experiment Station, 1888..... 710
" Second Annual Report of the Agricultural Experiment Station..... 421
Crawley, Edwin S. Elements of Plane and Spherical Trigonometry..... 418
Crocker, Joseph H. Different New Testament Views of Jesus..... 854
Crookshank, Edgar M. History and Pathology of Vaccination..... 275
Dabney, W. D. The Public Regulation of Railways..... 134
Darwin, Charles. Journal of Researches during the Voyage of H. M. S. Beagle..... 271
Davis, Eben H. The Fourth Reading-Book..... 421
Dawson, J. William. Handbook of Geology..... 416
Dawson, N. H. R. Report of the Commissioner of Education for 1887–'88..... 134
Dudley, William L. The Nature of Amalgams..... 708
Durham, William. Evolution, Antiquity of Man, Bacteria, etc..... 559
Earl, A. G. The Elements of Laboratory Work..... 417
Ebers, Georg. Joshua..... 561
Ecker, Alexander. The Anatomy of the Frog..... 131
Eckstein, Ernst. Nero..... 561
Eimer, G. H. T. Organic Evolution as the Result of the Inheritance of Acquired Characters..... 557
Existence, The, of a Positive, Constructive Side to Free Thought..... 561
Ferree, Barr. Primitive Architecture..... 421

Books noticed: PAGE
Fiske, Amos K. Midnight Talks at the Club 556
Fitch, J. G. Notes on American Schools and Training Colleges 418
Fontaine, William M. The Potomac or Younger Mesozoic Flora 700
Foster, William E. References to the Constitution of the United States. 561
Frédéricq, Paul. The Study of History in Germany and France 705
Friese, Philip C. Semitic Philosophy 700
Fullerton, George S. On Sameness and Identity 709
Fyffe, C. A. A History of Modern Europe. Vol. III 416
Geddes, Patrick, and J. A. Thomson. The Evolution of Sex 845
Gilbert, G. K. The History of the Niagara River 420
Goode, G. Brown. The Literary Labors of Benjamin Franklin 853
" Museum History and Museums of History 853
" Origin of the National Scientific and Educational Institutions of the United States 853
Goodwin, William W. Syntax of the Moods and Tenses of the Greek Verb 854
Gould, George M. A New Medical Dictionary 415
Griswold, W. M. Directory of Writers for the Literary Press 562
Grossmann, Louis. Maimonides 709
Guimps, Roger de. Pestalozzi, his Life and Work 701
Hackel, Eduard. The True Grasses 559
Hale, Horatio. Manual of the Oregon Trade Language, or Chinook Jargon 419
Halsted, Byron D. Rusts, Smuts, Ergots, and Rots 707
Hambleton, G. W. The Suppression of Consumption 710
Heilprin, Angelo. The Bermuda Islands 277
Henshaw, Samuel. A Bibliography of American Economic Entomology. Parts I, II, and III 560
Hornaday, William T. The Extermination of the American Bison 276
Howe, Henry M. The Metallurgy of Steel. Vol. I 846
Howland, George. Practical Hints for the Teachers of Public Schools .. 127
Hyde, E. W. Directional Calculus 854
Hubert, Philip G., Jr. Liberty and a Living 129
Illinois, University of. Bulletins of the Agricultural Experiment Station. 560
Iowa Agricultural Experiment Station. Bulletin No. 7 135
" State Board of Health. Monthly Bulletin 135
Iowa, State University of. Bulletin from the Laboratories of Natural History 852
James, Edmund J. The Federal Constitution of Germany, Translation of. 708
Johns Hopkins University. Studies in the Biological Laboratory. Vol. IV 852
Jordan, David Starr. A Report of Explorations in the Alleghany Region. 420
Journal of Morphology. Vol. III, No. 3 853
" Physiology. Vol. XI, Nos. 1, 2, and 3 853
Kansas Academy of Science, Transactions of. Vol. II 418
Kimball, Arthur L. The Physical Properties of Gases 555
Knoflach, Augustin. Sound-English 419
Kunz, George Frederick. Gems and Precious Stones of North America. 414
Langley, S. P. Report of the Secretary of the Smithsonian Institution for 1889 133

Books noticed: PAGE
Lee, Arthur B. The Microtomist's Vade-Mecum 560
Lesquereux, Leo. On some Fossil Remains 852
McCook, Henry C. American Spiders and their Spinning Work. Vol. I. 132
McGill University. Calendar of the Faculty of Medicine 853
" The Leading Facts of American History 854
Mack, Charles S. Philosophy in Homœopathy 709
Mackay, A. H. The Fresh-water Sponges of Canada and Newfoundland 852
MacQueary, Howard. The Evolution of Man and Christianity 554
Mantegazza, Paolo. Physiognomy and Expression 847
Massachusetts Agricultural College. Twenty-seventh Annual Report 135
" State Agricultural Experiment Station. Report for 1889. 560
Mearns, Edgar A. (Zoölogical and Botanical Papers) 562
Meteorological Observations made on Pike's Peak 133
Meteorological Society, New England, Observations of the, for 1888 133
Miller, S. A. North American Geology and Paleontology 272
Mills, E. J., and F. J. Rowan. Fuel and its Applications 128
Modern Science Essayist 133
Montgomery, D. H. Heroic Ballads 421
Moorehead, Warren K. Fort Ancient 273
Myerovitch, M. The Origin of Polar Motion 852
National Association of Wool Manufacturers. Bulletin for June, 1890 853
Newberry, John S. The Palæozoic Fishes of North America 706
New Jersey. Report of the State Geologist for 1889 848
New York. Report of the State Board of Charities for 1889 855
Nichols, George W. Letters from Waldegrave Cottage 561
Noel, Edward. Natural Weights and Measures 419
Ostrom, Kurre W. Massage and the Original Swedish Movements 135
Owen, Edmund. A Manual of Anatomy for Senior Students 850
P., G. W. American Whist illustrated 421
Panin, Ivan. Lectures on Russian Literature 278
Patton, Simon N. The Economic Basis of Protection 703
Peckham, George W. and Elizabeth G. Observations on Sexual Selection in Spiders of the Family Attidæ 279
Platt, James. Money 135
Poisons and their Antidotes 708
Poteat, W. L. A Tube-building Spider 562
Powell, J. W. Eighth Annual Report of the United States Geological Survey 704
" Fifth Annual Report of the Bureau of Ethnology, 1883–'84 274
Proctor, Richard A. The Student's Atlas 703
Quarterly Review of the United Brethren in Christ 853
Rankin, Francis H. Hygiene of Childhood 418
Remondino, P. C. The Marine Climate of the Southern California Coast 707
Report of the Royal Commission on the Mineral Resources of Ontario 702
Ribot, Th. The Psychology of Attention 275
Richardson, B. W. National Health 705
Richardson, Rufus B. Æschines against Ctesiphon 420

Books noticed: PAGE
Ridgway, Robert. List of Birds collected on the Island of Santa Lucia, etc. 420
" Review of the Genus Sclerurus.... 420
" " " " Xiphocolaptes.... 420
Salomons, David. Electric Light Installations and the Management of Accumulators.... 418
Scheffel, Joseph Victor von. Ekkehard.... 561
Sensenig, David M. Numbers Universalized.... 417
Shaffer, Virginia C. How to remember History.... 710
Shufeldt, R. W. Remarks upon Extinct Mammals of the United States. 279
Sickels, Ivin. Exercises in Wood-Working.... 130
Small, Albion W. The Beginnings of American Nationality.... 705
Smith, Alexander. Dreamthorpe.... 708
Spencer, David E. Local Government in Wisconsin.... 705
Sterrett, J. MacBride. Studies in Hegel's Philosophy of Religion.... 557
Strasburger, E. Handbook of Practical Botany.... 276
Stuart, George H., The Life of.... 709
Sutton, J. B. Evolution and Disease.... 849
Thaxter, Roland. Fungicides.... 560
Thayer, William R. The Best Elizabethan Plays.... 854
Thornton, John. Advanced Physiography.... 706
Thurston, Robert H. Heat as a Form of Energy.... 851
Tolstoi, Leo. The Kreutzer Sonata.... 710
Thorpe, T. E. A Dictionary of Applied Chemistry. Vol. I.... 418
United States Department of Agriculture. Bulletin No. 22.... 707
" Fish Commission. Bulletin for 1887.... 420
" Geological Survey. Bulletins 54, 55, 56, and 57.... 700
University of Iowa. Bulletin from the Laboratories of Natural History. 278
University Studies.... 853
Walker, Francis A. First Lessons in Political Economy.... 127
Ward, Lester F. The Course of Biologic Evolution.... 706
" The Geographical Distribution of Fossil Plants.... 278
Ward, R. H. Plant Organization.... 418
Wells, Roger, Jr., and John W. Kelly. English and Eskimo Vocabularies.... 708
Wendel, F. C. H. History of Egypt.... 274
Wentworth, G. A. School Algebra.... 708
Wheelbarrow. Articles and Discussions on the Labor Question.... 849
Wheeler, George M. Report upon United States Geographical Surveys. Vol. I.... 847
Whiting, Harold. A Short Course of Experiments in Physical Measurement. Part I.... 558
Willard, Frances E. Glimpses of Fifty Years.... 702
Winchell, N. H. Geological and Natural History Survey of Minnesota... 279
Wolff, Alfred R. The Ventilation of Buildings.... 421
Wood, Alphonso. Lessons in the Structure, Life, and Growth of Plants. 278
Yeo, I. Burney. Food in Health and Disease.... 415
Young, Charles A. The Elements of Astronomy.... 181
Zoe.... 852
Botanic Gardens, The, at Kew. F. A. Fernald.... 106
Botany, Teaching the "New." (Misc.).... 424

PAGE
Brain, Centers of Ideation in the.* B. Hollander..... 514
Bridge, A Papuan. (Misc.)..... 571
Brooks, Margarette W. Insect Pests of the House*..... 333

California and its Mines. (Misc.)..... 856
Canada, The Unexplored Regions of. (Misc.)..... 717
Caprices of Soils. (Misc.)..... 856
Carlisle, The Lord Bishop of. Wallace on "Darwinism"..... 75
Cats and their Friendships.* W. H. Larrabee..... 91
Cements, Natural and Artificial. L. F. Griffin..... 253
Chemistry, Who should study. (Misc.)..... 573
Child, Addison. Vitiated Moral Teaching. (Corr.)..... 408
Chisholm, George G. Commercial Geography of South America..... 391
Church, The Lights of the, and the Light of Science. T. H. Huxley..... 631
Civic Evolution, The Circle of. (Misc.)..... 565
Clark, The late Henry James. (Misc.)..... 138
Claypole, Mrs. Katharine B. Recent Glacial Work in Europe..... 103
Clayton, H. Helm. Public Schools as affecting Crime and Vice. (Corr.)... 122
Cloud-Bursts. (Misc.)..... 281
Coffee in Brazil. (Misc.)..... 142
Coffin-Nails. (Misc.)..... 283
Color, Animal, The Uses of. E. B. Poulton..... 533
Commencement Days, Four. (Misc.)..... 567
Corporation Law, Concerning. A. G. Warner..... 323
Cotton-Spinning South and North. H. V. Meigs..... 798
Crystallization seen in the Act. (Misc.)..... 717

"Darwinism," Wallace on. The Lord Bishop of Carlisle..... 75
Dawson, Sir William, on Evolution. (Editor's Table)..... 841
Descartes, René, Sketch of. (With Portrait)..... 833
Discovery, The, of Invisible Worlds. H. J. Klein..... 501
Dishes, Odd, of the Olden Time. (Misc.)..... 284
Doctors, The Unselfishness of. (Misc.)..... 713
Doctrine of Spirits in New Guinea, The. (Misc.)..... 859

Earth-Carving, Nature's. (Misc.)..... 423
"Earthly Tabernacle," The. O. T. Miller..... 763
Economics, Practical. (Editor's Table)..... 123
Education and Crime. A. W. Gould..... 211
Education, Requisites of a Real. (Misc.)..... 569
Ennis, Jacob. (Misc.)..... 137
Evans, E. P. King Bomba's Philosophical Catechism..... 618
Evolution and the Distribution of Animals. D. S. Jordan..... 313, 505
Evolution of Chemical Truth. L. Olivier..... 814
Experimental Methods, Instruction by. (Misc.)..... 563
Expert Witness, Position of the. (Misc.)..... 423

Fairies, Slavonian. F. S. Kraus..... 684
Fall of Man, The, and Anthropology. A. D. White..... 577, 721

PAGE
Fernald, Frederik A. Ancient and Modern Ideas of Hell..... 489
" " Telpherage in Practical Use*..... 382
" " The Botanic Gardens at Kew..... 106
Ferree, Barr. Utility in Architecture..... 202
Firing Pottery-Kilns by Gas. (Misc.)..... 857
Fish-Hook, Evolution of the. (Misc.)..... 280
Fiske, John. Edward Livingston Youmans: the Man and his Work..... 1
Flax, Where, is Grown and Manufactured. (Corr.). J. J. Menzies..... 409
Flowers, Observations upon Doubling of. B. D. Halsted..... 374
Formation, The, of a New Island.* (Misc.)..... 713
Frédéricq, Léon. Sketch of Theodore Schwann. (With Portrait)..... 257

Gardening Classes of the Missouri Botanical Garden. (Misc.)..... 282
Geography, Commercial, of South America. G. G. Chisholm..... 391
Geological Formations, Interesting, in Kansas. (Misc.)..... 566
" Survey Work in Minnesota. (Misc.)..... 423
Geometry of Aboriginal Mounds. (Misc.)..... 862
Geysers, Soaping. (Misc.)..... 139
Glacial Action, Evidences of, in Southeastern Connecticut.* D. A. Wells... 196
" " in Virginia. (Corr.). F. Minor..... 551
Glacial Work in Europe, Recent. Mrs. K. B. Claypole..... 103
Glass-Worker, In the Atelier of a.* C. H. Henderson..... 157
Gould, A. W. Education and Crime..... 211
Greenland and the Greenlanders.* E. Reclus..... 302
Griffin, La Roy F. Natural and Artificial Cements..... 253
Groff, G. G. Sanitary Work in Great Disasters..... 459

Hallucinations, A Census of. W. James. (Corr.)..... 409
Halsted, Byron D. Observations upon Doubling of Flowers..... 374
Hammond, William A. Sumptuary Laws and their Social Influence..... 33
Harvey, A. E. Agriculture on the Plains. (Corr.)..... 122
Hart, Samuel. Invisible Assailants of Health..... 806
Headaches, The Eyes and. (Misc.)..... 572
Hell, Ancient and Modern Ideas of. F. A. Fernald..... 489
Henderson, C. Hanford. In the Atelier of a Glass-Worker*..... 157
Henshaw, Henry W. Missions and Mission Indians of California*..... 465
Heredity, Human. J. H. Stoller..... 359
Hill, David J. President Hill's Defense. (Corr.)..... 265
Hollander, Bernard. Centers of Ideation in the Brain*..... 514
Honey, Artificial, and Manufactured Science. A. Pringle..... 70
Horses, Wild.* E. L. Trouessart..... 626
Huntington, Oliver W. A Talk about Meteorites..... 366
Huxley, Thomas Henry. The Lights of the Church and the Light of Science..... 631

Iles, George. Sketch of Thomas Corwin Mendenhall. (With Portrait)..... 590
Indian, American, Origin of the. (Misc.)..... 716
Indian Ball-Player's Training, An. (Misc.)..... 862
Indian Tribes of the Amazon. (Misc.)..... 859

PAGE
Insanity, Causes of. (Misc.) 138
Insect Pests of the House.* M. W. Brooks 333
Inventions, Half a Century of. (Misc.) 428
Invisible Assailants of Health. S. Hart 806
Irrigation in China. Tcheng Ki Tong 821

James, William. A Census of Hallucination. (Corr.) 409
Jameson, Charles Davis. The Suspension Bridge. (Corr.) 267
Jordan, David Starr. Evolution and the Distribution of Animals 313, 505
Justice, On. Herbert Spencer 19, 183

Klein, Hermann J. The Discovery of Invisible Worlds 501
Koenig, Rudolph, Sketch of. (With Portrait.) W. L. Stevens 545
Kraus, Friedrich S. Slavonian Fairies 684

Land Values, Natural Guides to. (Misc.) 282
Lands, Rights on other Men's. (Misc.) 139
Larrabee, William H. Cats and their Friendships* 91
Laundry, Science in the. (Misc.) 428
Law, Judge-made. (Misc.) 565
Lepidosirens. (Misc.) 859
Lias, Brau de St. Pol. Tin and its Native Land* 333
Lightning-Shock, Treatment of. (Misc.) 281
Liquor Laws not Sumptuary. G. F. Magoun 768

McCook, Henry C. The Strength of Spiders and Spider-Webs* 41
Magnetism, Local, and Geological Structure. (Misc.) 578
Magoun, George F. Liquor Laws not Sumptuary 768
Malaria, Trees and. (Misc.) 285
Manatee, Habits of the. (Misc.) 284
Manual Training, The Educational Value of. (Misc.) 138
Marcet, William. Atmospheric Dust 177
Marital Customs, Primitive. (Misc.) 570
Marriage Ages in England. (Misc.) 573
Maury, Matthew Fontaine, Sketch of. (With Portrait) 400
Mearns, Edgar A. Ancient Dwellings of the Rio Verde Valley* 745
Medicinal Plants. (Misc.) 858
Meigs, Henry V. Cotton-Spinning South and North 798
Meigs, William M. The Mysterious Music of Pascagoula. (Corr.) 410
Mendenhall, Thomas Corwin, Sketch of. (With Portrait.) G. Iles 590
Mendenhall, T. C., The Education of. (Editor's Table) 698
Mental Strain. C. Richet 485
Menzies, J. J. Where Flax is Grown and Manufactured. (Corr.) 409
Mercury, Scenes on the Planet. G. V. Schiaparelli 64
Merrill, Frederick J. H. Barrier Beaches of the Atlantic Coast 736
Mesozoic Atlantic Coast Region, The. (Misc.) 140
Meteorites, A Talk about. O. W. Huntington 366
Mexico, Messrs. Heilprin and Baker's Survey of. (Misc.) 861
Microscopic Structure of Stone. (Misc.) 715

PAGE
Miller, Olive Thorne. The "Earthly Tabernacle"..... 768
Minor, Francis. Evidences of Glacial Action in Virginia. (Corr.)..... 551
Missions and Mission Indians of California.* H. W. Henshaw..... 465
Moral Issue, A. (Editor's Table)..... 410
Moral Teaching, Vitiated. (Corr.). Addison Child..... 408
Mosquito Pest, Can the, be mitigated?..... 679
Mosquitoes, Dragon-Flies and. (Misc.)..... 714
Mounds of the Mississippi Basin. (Misc.)..... 564
Mothers and Natural Science. M. A. Aber..... 788
Mouth-slitting Botocudos, The. (Misc.)..... 858
Museum of the University of Pennsylvania. (Misc.)..... 283
Musical Sense, The, in Animals and Men. A. Weismann..... 352
Musical Visions. (Misc.)..... 572

"Nampa Image," The Genuineness of the. (Misc.)..... 718
New Chapters in the Warfare of Science. A. D. White.....145, 289, 577, 721
New Guinea, Some People of. (Misc.)..... 716
Nitrogen, Atmospheric, as Food for Plants. (Misc.)..... 142
Notes..... 143, 286, 430, 574, 718, 862
Nursing as against Artificial Feeding. (Misc.)..... 568

Obituary Notes..... 144, 287, 432, 576, 720, 864
Object-Studies in Botany. (Misc.)..... 142
Olives and their Oil. (Misc.)..... 141
Olivier, Louis. The Evolution of Chemical Truth..... 814
Ordeal by chewing Rice, The. (Misc.)..... 427

Palæolithic Implements in the United States. (Misc.)..... 425
Pallas Cormorant, The. (Misc.)..... 860
Pascagoula, The Mysterious Music of. (Corr.). W. M. Meigs..... 410
Pasteur's Anti-Rabic Treatment, Results of. (Misc.)..... 716
Peruvian Cloths, Ancient. (Misc.)..... 568
Pet, A Queer.* E. W. Bellamy..... 528
Philosophical Catechism, King Bomba's. E. P. Evans..... 618
Philpott, Henry J. A Little Boys' Game with a Ball..... 650
Pike, Voracity of a. (Misc.)..... 427
Pine Belt of New Jersey, The. (Misc.)..... 858
Poisoned Arrows, The Nature of. (Misc.)..... 140
Poulton, Edward B. The Uses of Animal Color..... 533
Pringle, Allen. Artificial Honey and Manufactured Science..... 70
Prohibition Laws of Iowa, The. (Corr.). J. H. Trewin..... 551
Puma, Taming The. (Misc.)..... 429
Pygmies, The African. A. Werner..... 658

Rabies, Tests and Characteristics of. (Misc.)..... 566
Reclus, Elisée, Greenland and the Greenlanders*..... 302
" Some Natives of Australasia*..... 607
Relative Abundance of the Chemical Elements. (Misc.)..... 860
Religion, Why so many Definitions of? F. N. Riale..... 343

PAGE
Riale, Frank N. Why so many Definitions of Religion? 348
Rice and its Culture. L. W. Robarts 827
Richet, Charles. Mental Strain 485

Sanitary Work in Great Disasters. G. G. Groff 459
Schiaparelli, G. V. Scenes on the Planet Mercury 64
School, Secondary, Programmes. G. W. Beaman 48
Schools, Public, as affecting Crime and Vice. (Corr.). H. H. Clayton 122
Schoolcraft, Henry R., Sketch of. (With Portrait) 113
Schwann, Theodor, Sketch of. (With Portrait.) L. Frédéricq 257
Science and Poetry. (Misc.) 425
Science in Iowa. (Misc.) 712
Scientific Association, The Australasian. (Misc.) 564
Scientific Missions in the Olden Time. (Misc.) 569
Scott, Robert H. Thunder-Storms 538
Sharing of Earnings. (Misc.) 425
Skilton, James A. The Affirmative Side of Agnosticism 217
Slag, Uses of. (Misc.) 712
Soda Salts in Arizona. (Misc.) 285
Spencer, Herbert. On Justice 19, 183
Spencer, Does Mr., inculcate Selfishness? (Editor's Table) 267
Spencer's, (Mr.) Place in Philosophy. (Editor's Table) 551
Spiders and Spider-Webs, The Strength of.* H. C. McCook 41
Squirrel, An Arizona. (Misc.) 564
Staten Island, Contributions to the Geology of. (Misc.) 142
Stevens, W. Le Conte. Sketch of Rudolph Koenig. (With Portrait) 545
Stoller, James H. Human Heredity 859
Summer Courses at Harvard. (Misc.) 423
Summit of Kilima-njaro, The. (Misc.) 860
Sumptuary Laws and their Social Influence. W. A. Hammond 33
Suspension Bridge, The. (Corr.). C. D. Jameson 267
Symbols, The Migration of. Count G. d'Alviella 671, 778

Tariff Legislation. (Editor's Table) 696
Tariff Question, Common Sense applied to the. E. Atkinson 433, 591
Teheng Ki Tong. Irrigation in China 821
Telpherage in Practical Use.* F. A. Fernald 382
Thunder-Storms. R. H. Scott 538
Tin and its Native Land.* B. de St. P. Lias 233
Torres Strait, Holy Things and Toys from. (Misc.) 286
Towers, Leaning. (Misc.) 424
Training in Realities. (Editor's Table) 125
Trewin, James H. The Prohibition Laws of Iowa. (Corr.) 551
Trouessart, Edouard L. Wild Horses* 626

University, The Work of a Complete State. (Misc.) 567

Voice-Figures on Glass. (Misc.) 429

Walking-Sticks and Umbrella-Handles. (Misc.) 714

PAGE
Walls and Ceilings, Healthful. (Misc.) 573
Warfare, Submarine, Antiquity of. (Misc.) 426
Warner, Amos G. Concerning Corporation Law 823
Water-Supply, The, of Memphis. (Misc.) 711
Weismann, August. The Musical Sense in Animals and Man 852
Wells, David A. Evidences of Glacial Action in Southeastern Connecticut*. 196
Werner, A. The African Pygmies 658
White, Andrew D. The Antiquity of Man and Egyptology 145
" The Antiquity of Man and Prehistoric Archæology 289
" The Fall of Man and Anthropology 577, 721
Wilson, M. C. Apparatus-Making in Education* 345

Youmans, Edward Livingston: the Man and his Work. John Fiske 1

END OF VOL. XXXVII.

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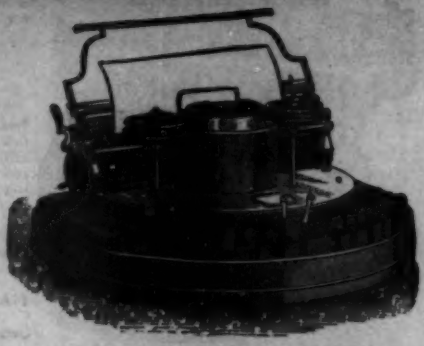

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JULY, 1890.

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CONTENTS.

PAGE

I. New Chapters in the Warfare of Science. IX. The Antiquity of Man and Prehistoric Archæology. By ANDREW D. WHITE. 289
II. Greenland and the Greenlanders. By ELISÉE RECLUS. (Illus.) . 302
III. Evolution and the Distribution of Animals. I. By D. S. JORDAN. . 313
IV. Concerning Corporation Law. By Prof. AMOS G. WARNER. . . . 323
V. Insect Pests of the House. By Miss M. W. BROOKS. (Illus.) . . . 333
VI. Apparatus-Making in Education. By M. C. WILSON. (Illus.) . . . 345
VII. Why so Many Definitions of Religion? By F. N. RIALE, Ph. D. . 348
VIII. The Musical Sense in Animals and Men. By AUG. WEISMANN . . 352
IX. Human Heredity. By Prof. JAMES B. STOLLER. 359
X. A Talk about Meteorites. By OLIVER W. HUNTINGTON, Ph. D. . 366
XI. Observations upon Doubling of Flowers. By B. D. HALSTED, Sc. D. 374
XII. Telpherage in Practical Use. By F. A. FERNALD. (Illus.) 389
XIII. Commercial Geography of South America. By G. G. CHISHOLM . 391
XIV. Sketch of Matthew Fontaine Maury. (With Portrait.) 400
XV. Correspondence: Vitiated Moral Teaching.—Where Flax is grown and manufactured.—A Cause of Hallucinations.—The Mysterious Music of Pascagoula . 408
XVI. Editor's Table: A Moral Issue 410
XVII. Literary Notices 413
XVIII. Popular Miscellany 423
XIX. Notes 430

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Amount of net assets, January 1, 1889 ..... $89,824,336 19

REVENUE ACCOUNT.

Premiums	$26,021,[illegible]	
Less deferred premiums, January 1, 1889	1,635,7[illegible]	$24,385,921 20
Interest and rents, etc.	5,028,[illegible] 58	
Less interest accrued January 1, 1889	451,603 24	4,577,345 14—$29,183,266 34
		$118,987,602 53

DISBURSEMENT ACCOUNT.

Losses by death, and endowments matured and discounted (including reversionary additions to same)		$6,230,035 50
Dividends (including mortuary dividends), annuities, and purchased insurances		2,869,026 16
Total paid policy-holders	$[illegible]	
Taxes and reinsurances		839,737 17
Commissions (including advanced and commuted commissions), brokerages, agency expenses, physicians' fees, etc.		4,735,632 84
Office and law expenses, rentals, salaries, advertising, printing, etc.		860,768 50—$17,960,279 97
		$101,027,322 46

ASSETS.

Cash on deposit, on hand, and in transit		$5,917,837 72
United States bonds and other bonds and stocks (market value, $50,438,441 91)		38,412,169 41
Real estate		23,291,871 87
Bonds and mortgages, first lien on real estate (buildings thereon insured for $14,500,000 and the policies assigned to the Company as additional collateral security)		18,106,512 50
Temporary loans (market value of securities held as collateral, $1,671,583)		1,319,600 00
*Loans on existing policies (the reserve on these policies, included in liabilities, amounts to over $2,000,000)		587,324 29
*Quarterly and semi-annual premiums on existing policies, due subsequent to January 1, 1890		1,635,845 37
*Premiums on existing policies in course of transmission and collection. (The reserve on these policies, included in liabilities, is estimated at $1,700,000)		1,324,253 62
Agency balances		90,329 51
Accrued interest on investments January 1, 1890		441,344 64—$105,027,300 46
*Market value of securities over cost value on Company's books		4,026,278 50

*A detailed schedule of these items will accompany the usual annual report filed with the Insurance Department of the State of New York.

TOTAL ASSETS, January 1, 1890 ..... $105,053,600 96

Appropriated as follows:

Approved losses in course of payment		$440,517 67
Reported losses awaiting proof, etc.		375,398 [illegible]
Matured endowments, due and unpaid (claims not presented)		40,592 49
Annuities due and unpaid (claims not presented)		69,964 51
Reserved for reinsurance on existing policies (Actuaries' table 4 per cent interest)		88,594,185 00
Reserved for contingent liabilities to Tontine Dividend Fund, January 1, 1889, over and above a 4 per cent reserve on existing policies of that class	$6,453,772 13	
Addition to the fund during 1889	2,300,540 16	
	$8,754,312 29	
DEDUCT—		
Returned to Tontine policy-holders during the year on matured Tontines	1,049,264 18	
Balance of Tontine Fund, January 1, 1890		7,705,048 11
Reserved for premiums paid in advance		40,040 73
		$97,535,777 68
Divisible surplus (Company's new standard)		7,517,823 28
		$105,053,600 96
Surplus by the N. Y. State standard (including the Tontine Fund)		15,600,000 00

From the undivided surplus, as above, the Board of Trustees have declared a reversionary dividend to participating policies in proportion to their contribution to surplus, available on settlement of next annual premium.

Returns to Policy-holders.	*Insurance in Force.*	*Assets.*	*New Policies Issued.*
1887 ..... $9,535,820	Jan. 1, 1888 ..... $358,035,536	Jan. 1, 1888 ..... $83,079,843	1887 28,522
1888 10,973,099	Jan. 1, 1889 419,886,305	Jan. 1, 1889 91,460,188	1888 33,334
1889 12,121,121	Jan. 1, 1890 495,601,970	Jan. 1, 1890 105,053,600	1889 39,499

Number of policies issued during the year, 39,499. New insurance, $157,119,082.
Total number of policies in force January 1, 1890, 150,382. Amount at risk, $485,601,970.

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